# ENHANCEMENT OF LATENT PRINTS

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Before we speak about Enhancement of Latent Prints we must review why Enhancement is necessary. If the only techniques used for the development of latent prints on non-porous evidence is the Brush and Powder method, we will not need enhancement.
Over the past 17 or more years, we have found that best way to preserve latent prints during transportation is "Superglue Fuming." This technique has been discussed more than any other technique since the introduction to the United States, from Japan by Paul Norkus and Edward German in April 1980.
The following information has been taken from the US Army Criminal Investigation Laboratory Technical Processing Manual.

## "SUPERGLUE" FUMING

**SAFETY:** Cyanoacrylate ester fumes are strongly irritating to the eyes and respiratory system. Fuming should only be conducted in a well ventilated area and non-porous gloves should be worn to prevent skin contact.
"Super Glue" is a trade name of Duro, a subsidiary of Loctite Corporation. As used herein, "super glue" is a generic reference to any of a number of brands of cyanoacrylate esters or methyl esters, widely available in a variety of viscosities.
Fuming with cyanocrylate ester (super glue) will cause latent print residue on a variety of non-porous (and some semi-porous) surfaces to appear white in color.
Cyanoacrylate ester fumes are monomers that polymerize onto contaminates such as latent print ridge detail at a rate different from surrounding substrates. Latent prints thus developed are fused to the surface and not easily damaged.
Latent print development with super glue fumes can be accomplished by the use of a fuming chamber (cardboard box, plastic bag, aquarium, etc.) or commercially available fuming gun.
The liquid glue is placed in a disposable container (aluminum foil works well), for easy clean-up purposes, and this container is then placed in the bottom of the fuming chamber. The number of drops to be added is primarily dependent upon the size of the particular fuming chamber and the surface area of the item to be fumed.
Some Crime Scene Technicians prefer heating the chamber or the surface upon which the drops of glue are deposited to expedite the development process.
This can be accomplished with a coffee cup warmer or a light fixture assembly (60 watt bulb). **DO NOT USE A HOT PLATE OR DIRECT FLAME.** The super glue is placed in the bottom half of a soda can and the can is set on top of the light bulb. (Note: Do not let the light bulb touch the walls of a cardboard 'chamber' or the evidence as this may start a fire.
It should be noted, that heating the chamber can cause a glaze-like coating to cover the entire evidentiary surface resulting in considerable loss of contrast in some extreme instances. Care must also be exercised to not "boil" the cyanoacrylate ester causing a spattering of residue on nearby evidence.
There are also a variety of non-heat source accelerated methods. Most involve plain cotton impregnated with chemicals.
Cotton batting or gauze should be cut into workable "patches" (5 cm by 5 cm is adequate) and then immersed into the chemical solution. Any excess liquid is squeezed from the cotton and the "patch" allowed to dry.
**SAFETY:** When using sodium hypochlorite (bleach) or sodium hydroxide on a patch as a fuming accelerant, protect the skin from contact with these strong oxidizers and ensure adequate ventilation is present.
"Household" bleach is one chemical used for the cotton gauze.
A 4.0% (w/v) aqueous solution of sodium hydroxide also works well. Exact concentration has been shown to be of little importance, with successful results sometimes coming from merely using a saturated solution of sodium hydroxide.
For use, a "patch" should be elevated above the floor of the fuming chamber (a "u"-shaped piece of wire mesh makes a good platform for the "patch") and the super glue should be liberally applied to the patch after evidence has been positioned in the chamber.
An almost immediate reaction with the chemically impregnated cotton will occur and visible traces of fumes should initially appear.
Successful development of ridge detail on plastic bags has been accomplished in less than ten minutes using such "patches". Development should be allowed to continue until optimal contrast is achieved.
Use of commercially available cyanoacrylate packets is slower than heat or chemically accelerated fuming development, but is easy to use without the necessity for handling chemicals.
The addition of humidity to the fuming chamber plays a major role in successful development of white ridge detail in latent prints.
To allow maximum exposure of fumes to the item being super glue fumed it should be hung up, stood up, or leaned on its edge inside the chamber.

Test prints on a similar surface should be exposed to the super glue fumes at the same time as the item fumed. This test print will help to determine the length of time needed for polymerization to occur on your item.

Close the fuming 'chamber' and turn on the heat for ten minutes for a small chamber and 20 minutes for a large chamber. Check the test print and either add more super glue and continue to fume at five-ten minute intervals or stop if the test print is visible.

Additional latent prints will tend to develop on leather products even after initial super glue fumed prints are visible if fuming is continued. Care should be taken to photograph those visible latents and **then** to continue to super glue fume the leather for additional development. 10-15 minute intervals are suitable until such time as the examiner feels all latents have been developed.

Additional physical or chemical processing techniques are difficult to conduct on leather due to the nature of the grain and the absorbency of the leather itself. Super glue fuming is the main technique used on these items.

Sometimes over development will occur, usually in the form of a heavy white deposit obscuring most of a latent print. Using an adhesive lifting technique (tape, lifter, etc.) is effective in lifting away the heavy upper deposits, revealing underlying ridge detail.

**SAFETY:** When using any of the recommended chemical cleaning agents for removing cyanoacrylate deposits (acetone, acetonitrile, or DMSO) only butyl rubber gloves will provide adequate hand protection. These cleaning agents should only be used in a well ventilated area. As always, a lab coat and eye protection should be worn when working with any chemical.

Cleaning agents for the removal of cyanoacrylate deposits in fuming chambers, vehicles, etc., include soapy water, acetone, and acetonitrile (sometimes sold commercially as cyanoacrylate ester deposit remover). One of the most efficient solvents is di-methylsulfoxide (DMSO, also called methyl sulfoxide) which easily dissolves deposits. DMSO has a garlic-like smell and should be applied wearing gloves. The common commercial brand solvent WD-40 also removes deposits reasonably well, and may be the preferable solvent for cleaning a vehicle.

# DYE STAINS

## RHODAMINE 6G

Rhodamine 6G is a dye stain used for latent print luminescence in conjunction with lasers and alternate light sources, and cyanoacrylate ester (super glue) fuming on non-porous evidence.

Neither the laser nor the Rhodamine 6G actually develops latent print ridge detail. The ridge detail must already be enhanced through super glue fuming. The Rhodamine 6G and laser merely improve the contrast of the minute or previously invisible latent prints.

If necessary, Rhodamine 6G can be readily used after "dusting" with fingerprint powders; however, it is recommended that the dye stain be used prior to dusting. The powder will not interfere with proper Rhodamine 6G application in that the one or two-step liquid rinses remove heavy powder deposits. Items should always be tested for background staining prior to overall staining.

Use of an inexpensive solvent (lowest grade) such as methanol will normally provide excellent results.

Use of an aqueous (water) solution in lieu of methanol is done to develop latent prints on fibrous tapes, items with lacquer coatings (i.e., rifle stocks), leathers and somewhat porous plastics which would normally be damaged with a methanol solvent.

Application of the 'one-step' Rhodamine 6G dye involves rinsing the non-porous evidentiary surfaces (previously processed with super glue and/or powder) with the dye stain.

Application of the 'two-step' Rhodamine 6G dye involves rinsing the item as in the 'one-step'. Then, a second rinse using "clean" methanol is conducted to remove all visible (by room light) traces of the orange Rhodamine 6G.

The rinse can be gathered in a pan or container which will allow it to be reused many times provided excessive contaminants are not present. Most powder and soil loosened during the Rhodamine 6G application will remain in the bottom of the container you use to catch the rinse.

When deposits of Rhodamine are heavy enough to see in room light often they will not luminance via laser illumination and can obscure any underlying ridge detail.

Examine Rhodamine 6G processed items using 510 nm (blue-green) laser light while wearing anti-laser goggles (orange color filters). Excitation of Rhodamine occurs at 510 or 514.5 nm.)

When ordering Rhodamine 6G dye for evidence rinsing, care should be taken to specify non-laser grade Rhodamine 6G. Laser grade is far more expensive than non-laser grade.

## ARDROX P-133D (aka ARDROX) -

Ardrox P-133D is an industrial penetrate developed to detect small fractures in construction materials. It possesses certain properties, which allow it to be readily used in latent print processing.

Ardrox P-133D, like Rhodamine 6G, is a dye stain used for latent print luminescence in conjunction with lasers and alternate light sources, and cyanoacrylate ester (super glue) fuming on non-porous evidence. Since these stains are compatible Ardrox can be used in conjunction with Rhodamine 6G.

Remember to always test an area for background staining prior to staining with Ardrox.

Ardrox can be utilized full strength from the container or diluted to various strengths with methanol. This will depend upon the nature of the item being stained. Ardrox staining generally requires a water rinse, but caution must be exercised when examining surfaces which may be damaged by water, such as gun metal. This does not prevent the use of Ardrox in undiluted or diluted form, but does eliminate the water rinse portion.

Application of Ardrox may be by dipping or washing.

Place the super glue fumed item into the Ardrox for about ten minutes or wash the surface area with the stain and allow it to remain for ten minutes.

Excess stain is removed by placing the item under running tap water until no yellow color remains.

Examine the Ardrox processed item using 510 nm (blue-green) laser light while wearing anti-laser goggles (orange color filters). Excitation of Ardrox occurs at 470 nm.

Even though Ardrox and Rhodamine 6G can be used in any order, Ardrox staining is removed by methanol while Rhodamine 6G will not be removed by a water rinse. Therefore, when using both stains on an item the Ardrox should be used prior to the Rhodamine 6G.

## AMIDO BLACK

Amido Black is a dye which stains protein present in blood to give a blue-black product and is therefore used for enhancing latent impressions produced by blood contamination.

Note: **Blood marks must be carefully evaluated and coordinated with other Forensic Scientists to preclude destruction of potentially valuable evidence**. Occasionally it will be necessary to decide which of two (or more) procedures may produce the more valuable findings, i.e., the possibility of enhancing unidentifiable ridge detail to positively identify a suspect versus the potential value of serological findings.

Amido Black is suggested for those situations where there is blood contamination of the underlying or surrounding area of the slightly visible ridge characteristics, or where the impression is caused by a "lifting away" (negative image) of the contaminated (blood) surface coating.

Amido black will only stain traces of blood present. It will not develop areas of a latent print containing only the normal constituents of perspiration.

All blood must be dried prior to application.

Blood proteins must be fixed prior to amido black.

If the blood impression has been dried for more than 14 days it is considered 'fixed'.

When the blood impression has not been dry for at least 14 days then it must be 'fixed' by one of following methods:

The blood impression, if possible, should be washed with a methanol rinse. The first amido black rinse which contains methanol will suffice for this 'fixing' rinse.

If it is not possible to use the methanol rinse due to the composition of the evidence then it should be baked:

Either, bake non-heat-sensitive evidence at 100 degrees Centigrade for thirty minutes; or,

Bake heat-sensitive items at a lower temperature for a longer time.

When possible all non-porous items of blood evidence should be super glue fumed to protect other possible latent prints. Super glue fuming does not appear to harm the blood impression for latent print work.

Caution must be exercised when applying the methanol based formula to painted, varnished or lacquered surfaces. This formula may destroy the surface beneath the latent print as well as the latent.

## LASER

LASER (Light Amplification by Stimulated Emission of Radiation)

**SAFETY:** Laser light sources are capable of causing serious damage to the eyes if not used appropriately. Special care should be taken when working with the class IV laser. Always ensure that the diffuser is in place during use and that the appropriate safety glasses are used for the wavelength in use. The class IV laser is marked as having a range of 400-800 nm. The orange goggles which are available have a protection range of 193-532 nm. Since the wavelengths used are 499 and 514.5 nm, these goggles should be sufficient. Care must be taken to ensure that the laser is not utilized at a wavelength above 532 nm. All personnel in the room should wear goggles and care should be taken not to create unwanted reflections and that the laser is never oriented towards the open doorway.

Light source discussions in the previous paragraphs have so far involved only the visible ranges of the electromagnetic spectrum. Visible parameters range from extreme violet (UV) below 400 nanometers (nm) to extreme red below 700 nm.

Almost all laser usage associated with latent print examination deals with Argon (Ar) ion lasers.

The fluorescence of latent print ridge detail has been found to occur at 488 and 515.5 nm wavelengths.

These two wavelengths are also the primary (strongest) wavelengths emitted by argon ion lasers during multi-line (broad band) output.

Lasers are technical electronic instruments and require interaction and care by the user to some extent. For Ar lasers, the more often they are operated (such as all day each day), the better they will operate in general over an extended period of time.

Commercial Argon ion lasers are available with average powers up to 20 Watts. The two strongest lines of their blue-green laser light are 488 and 514.5 nm. Twenty-three percent of the total power is at 488nm (blue-green) and forty percent at 514.5 nm (green). Argon ion lasers will occasionally fluoresce untreated latent print ridge detail, or, in some instances fluoresce background materials revealing dark (non-glowing) ridge detail.

They are most valuable for exciting special dyes and reagents tailored to cause latent print luminescence such as Rhodamine 6G and Zinc Chloride. These dye stains change the color of the previously developed ridge detail to enable excitation (luminescence) by a laser.

Rhodamine 6G luminesces well at all argon ion wavelengths and thus is best illuminated with broad band (all line wavelengths).

## Ultraviolet

**SAFETY: Short-wave ultraviolet exposure to the skin and eyes can be dangerous. Appropriate UV filter glasses, gloves and long sleeves should be utilized.**

Ultraviolet (UV) light is broken down into long-wave UV (between 320 and 380 nm) and short-wave UV (between 200 and 280 nm).

Non-Laser Luminescence Illumination Equipment.

**SAFETY:** To prevent eye injury, always check to ensure that the protective goggles used match the wavelength of light being utilized. Avoid exposing personnel without protection to the light source.

Used to produce a powerful, relatively narrow band of light at wavelengths between 340 nm and 550 nm. Used in conjunction with three types of goggles; yellow, orange and red.

Used to provide latent fingerprint detection in three different modes; photoluminescent, absorption and specific illumination.

The photoluminescent mode relies on some substance or combination of substances being present in the latent fingerprint deposit which absorbs the incident light (excitation light), thereby being transformed into an excited form, and re-emitting the absorbed energy in the form of light. This emitted light, termed photoluminescence, usually takes the form of fluorescence (short lived) and phosphorescence (long lived). In most cases, fluorescence is the only detectable emission and the term fluorescence is often used instead of the more general term photoluminescence. In the case of latent prints, the luminescent substance may be present in the natural print deposit (inherent luminescence), may have been transferred from a source of luminescent material via the fingers to the object (contamination), or may be chemically induced by treatment with specific chemical reagents (induced fluorescence).

The absorption mode is similar to the photoluminescent mode in that a knowledge of the absorption spectrum of the sample is required. A wavelength band (color) is selected which corresponds to one of the compounds absorption regions. Irradiation of the sample is conducted, usually employing a low incident angle, and the sample viewed from above, using the naked eye or a TV camera. The latent print will appear as a black pattern on a background corresponding to the color of the incident light. As the light is absorbed by the ridges the print appears black; only the non-absorbing areas reflect the light and are colored by it.

The specific illumination mode is used to minimize the contribution of a particular color in a multi-colored object, such as latent prints developed with ninhydrin on a bank check.

A specific filter band would be selected and then fine tuned to obtain maximum suppression of the other colorings.

The Non-Laser Luminescence Illumination Equipment can be used not only in the laboratory, but also at crime scenes when searching for latent prints, blood, trace evidence, and shoe/tiretrack impressions.

**RUVIS** ( Reflected Ultraviolet Imaging Systems) - This device extends forensic examination capabilities into that portion of the light spectrum below 360 nm.

Ultraviolet (UV) illumination of forensic evidence without RUVIS is limited to the detection and recording of UV-excited luminescence in the visible spectrum in the same manner that laser and arc lamp excitation is used.

RUVIS is sometimes valuable for enhancing cyanoacrylate-developed latent prints. Faint cyanoacrylate-developed ridge detail that is transparent or translucent in room light can (400-700 nm) become relatively opaque at 250 nm.

Latent prints deposited in sebaceous matter or other oily residue that is typically clear in room light can sometimes be detected by RUVIS without the application of dusting powder or other sometimes destructive contaminants.

Latent prints more than a year old and invisible in room light have been detected by RUVIS without prior cyanoacrylate processing.

Latent fingerprints and footwear impressions deposited in the soft, thin top layer of floor wax on tile and linoleum floors (or other smooth surfaces) can often be seen using RUVIS alone, even though they are undetectable via laser, oblique lighting, electrostatic lifting, etc. The otherwise transparent top coating of floor wax appears similar to a coating of soft black tar on such surfaces regardless of the underlying coloration.

Operating RUVIS: **NOTE: Operation of this equipment requires prior training.**

**SAFETY**: Short wave and long wave UV sources are hazardous. While operating UV light sources it is necessary to wear clear or yellow goggles, cotton or rubber gloves, and to cover the arms and face if exposed. Never subject your eyes or face to UV light through a magnifying glass by examining items for ridge detail in this manner.

**Special Thanks to the members, and Retired members of the US Army Criminal Investigation Laboratory Latent Print Division, for sharing the above information with the members of the International Association for Identification.**