ML2-IR CRIME-LITE

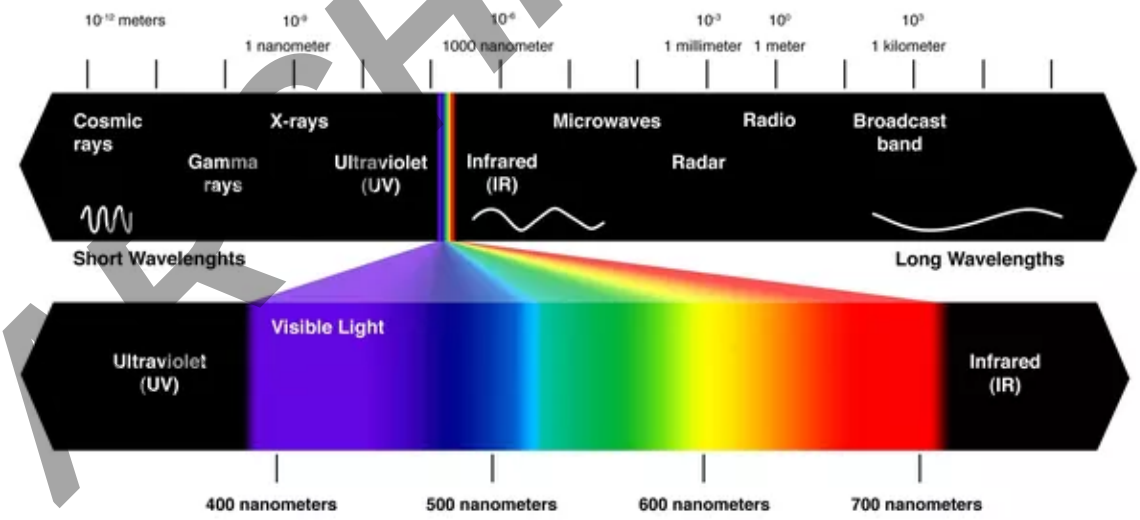
28.1 PURPOSE

28.1.1: To potentially aid the examiner in visualizing biological stains on evidentiary items.

A. Theory

Background:

The entire electromagnetic spectrum consists of cosmic rays, gamma rays, X-rays, Ultraviolet (UV) light, visible light, infrared (IR) light, microwaves, radar, radio waves, and broadcast bands. The very narrow electromagnetic spectrum that is useful to forensic examination consists of ultraviolet light, visible light and infrared light. This spectrum is often called the Visible Light Spectrum and is measured in nanometers (nm) whereby each nanometer range represents a wavelength or band of light.



1. The visible light spectrum is the range of wavelengths of electromagnetic radiation which our eyes are sensitive to. The range of this light spectrum that is visible to humans is approximately 380 nm to 780 nm.

a. "ROY G. BIV" reminds us that the visible spectrum goes from Red (the longer wavelength of light at ~700 nm), to Orange to Yellow to Green to Blue to Indigo and to Violet (the shorter wavelength of light at ~400 nm).

b. For example, when we perceive an object as being blue it means that most other wavelengths of light are absorbed by that object and the blue wavelengths are being reflected. Our eyes then see the object as blue in color.

2. Infrared (IR) wavelengths and Ultra-Violet (UV) wavelengths fall outside the visible spectrum.

   a. Infrared (IR) wavelengths are longer than Red wavelengths and carry little energy.

   b. Ultra-Violet (UV) wavelengths are shorter than Violet wavelengths, emit higher amounts of energy and are potentially harmful to humans.

Forensic Examination:

The ML2-IR Crime-lite is equipped with multi wavelength illumination to assist the examiner in potentially visualizing biological stains as follows: UV (350-380 nm), Blue (420-470 nm), Blue-Green (445-510 nm), White (400-700 nm), and Infrared (800-900 nm). Once an examiner is able to visualize or locate a potential biological stain, further examination and/or testing may be conducted.

1. The Ultraviolet (UV) light source (~350-380 nm) can assist an examiner with the detection of bloodstains on blue or red/purple fabrics. Bloodstains absorb the UV light without reflection or emission of fluorescence. The bloodstains will appear black.

When using light wavelengths within the Ultraviolet (UV) spectrum, one should never look directly into the light source without filter goggles. Even though the ***emitted*** fluorescence from the examined item falls into the visible spectrum, viewing goggles or a UV sensitive digital camera that is fitted with a filter are used to enhance visibility. The digital UV sensitive camera is able to capture an image of the emitted UV light from the substance being examined.

2. The Blue (~420-470 nm) and Blue-Green (~445-510 nm) light sources within the visible spectrum can assist an examiner with the detection of semen, saliva and urine stains on evidence. When exposed to these light sources, the stains absorb the applied wavelengths and emit longer wavelengths of light, which we view as fluorescence with the use of the appropriate filters.

   More specifically, molecules in these biological stains are raised to an excited state by absorption of radiation from the blue or blue-green light. When these "excited" molecules return to a normal state, they emit energy in the form of fluorescence. The emitted fluorescence is at a longer wavelength (lower energy) than the excitation wavelength.

   Filters, in the form of viewing goggles or camera filters, must be used to block light from the light source (i.e. light not absorbed by the substrate) which allows us to view the emitted fluorescence of the stains.

3. When using the full spectrum of visible light, i.e. white light (~400-700 nm), light filters may be used to increase the contrast between a deposited sample and the substrate, thus aiding in the visualization of potential biological evidence.

   For example, when using the blue filter with the white light (~400-700 nm) it can assist an examiner with the detection of bloodstains on blue fabrics by increasing the contrast between the fabric (background) and the bloodstains.

4. The Infrared (IR) light source (800-900 nm) and IR sensitive camera can assist an examiner with the detection of a bloodstain on dark or patterned clothing. When exposed to this light source, the bloodstain absorbs the IR radiation while the fabric (background) may reflect the IR radiation resulting in an image of a greyish stain on a whitish background (as detected by the IR sensitive camera and viewed on the tablet screen).

B. Limitations (Limiting factors in the visualization of a deposited sample):
   1. Substrate interference
   2. Quantity (size) of deposited sample
   3. Quality (condition/dilution) of deposited sample

C. Note: This procedure is an examination aid. Further examination and testing is necessary to determine the presence or absence of a biological stain.

28.2 RESPONSIBILITY

Forensic Science Examiners (however titled) from the Division of Scientific Services who have been trained in the disciplines of blood and body fluid screening according to FB SOP-26 (Training Manual and Checklist) and GL-13 (General Evidence Handling).

28.3 SAFETY

Use appropriate measures for the proper handling of biohazardous materials, hazardous chemicals and alternate light sources according to GL-2 (Safety Manual).

28.4 DEFINITIONS

ALS: Alternate Light Source

28.5 MATERIAL

ML2-IR and related computer hardware

28.6 PROCEDURE

A. Refer to FB SOP-01 for instruction on cleaning utensils and laboratory areas (1.5.1), personal protective equipment (1.5.2) and evidence retrieval (1.5.3) and for additional instruction on evidence examination (1.5.4) including but not limited to documentation, collection, preservation, verification, sub-itemization, transfers/storage and LIMS.

B. For additional information, see the Crime-lite Cam User Manual and FB SOP-23 (Equipment Maintenance).

28.6.1 Light Source, Camera and Software:

A. Document the use of the ML2-IR on the appropriate QRW and clean the surfaces of the ML2-IR and the stylus with 10% bleach followed by ethanol.

B. Plug in the power cord to ML2-IR head (light source). A red light located on the ML2-IR head indicates that the light source is on. If the red light is not on, check that power cord is plugged into base of the arm.

C. Turn ON the tablet by pushing the button on upper left corner of the tablet. If the tablet battery is not charged (check lower right corner of screen), plug in the power cord to the tablet.

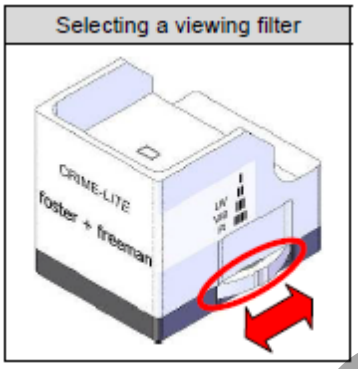
D. Inset thumb drive (ML2-IR thumb drive which is provided solely for this use) into the "4 Port USB 2.0 HUB". The thumb drive will be used to transfer your images from the tablet to a computer for long term storage and printing.

E. On the tablet, move the "Screen Saver" away by swiping with the stylus. The screen will then display: CrimeLite ML2 User "Sign In". With the styles, double tap the "Sign In" and the tablet desktop will be displayed.

F. The tablet desktop will display two folders where the images will be located: The CLC Grab folder (stores images taken with the "Grab Image" tool) and the Working folder (stores images taken with "Capture Evidence" tool).

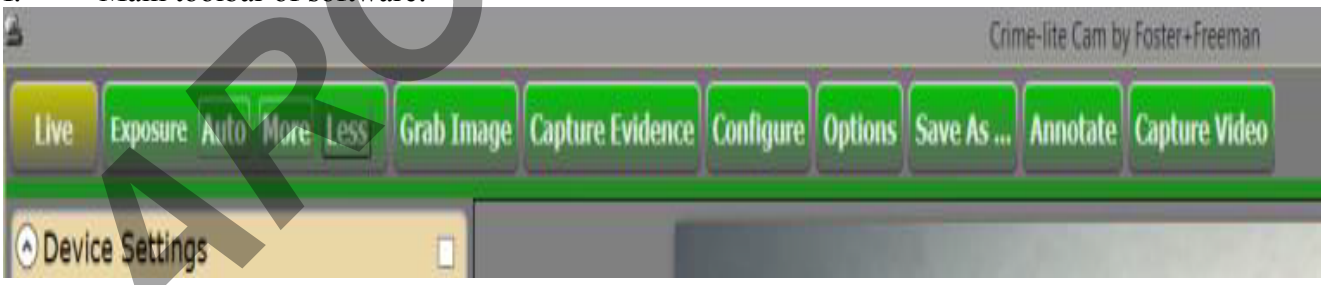
G. Activate the camera software by double tapping (with stylus) the "Ce-lite Cam" icon.

H. The camera filter is selected by rotating the filter disc to the appropriate filter setting. See chart below:



Filter setting	Camera assembly: Optical filters Transmission wavelengths (nm) UV (350 – 400)	VIS (400 – 700)	IR (> 700)
	☑	☑	☑
UV	☑	☒	☒
VIS	☒	☑	☒
IR	☒	☒	☑ (> 715)

I. Main toolbar of software:



1. The **Live** button allows the user to switch between the live camera image and the selected stored image. If the user is in live mode, the button appears yellow.

2. The **Exposure** control enables or disables the automatic exposure control ("**Auto**"). The "**Auto**" function attempts to produce an image of acceptable brightness. When "**Auto**" is enabled, the lettering is yellow.

The "**More**" and "**Less**" buttons are manual exposure controls that increase or decrease the image brightness.

3. The "**Grab Image**" button (also located on bottom-left corner of screen) captures an image. The image will be moved to the "CLC Grab" (**temporary storage**) and a thumbnail image will appear along the bottom of the screen. The "Grab Image" button does not associate "Case Details" with the image.

4. The "**Capture Evidence**" button captures an image and stores the image in the "Working Folder" (on the desktop). The "Device Settings" and "Case Details" **must** be completed.

If the settings and details are not filled in, an error message will appear when attempting to capture an image with the "Capture Evidence" button. For the "Device Settings" use the drop down options for "Light Source", "ML Filter" and "Camera Filter". Fill in "Case Details" using the screen

keyboard or an attached keyboard. The "Notes:" section is optional. The captured image consists of two files: a .tif image file and a .set text file.

5. The "**Configuration**" button on the toolbar is used to setup the options available in the "Device Settings".

6. The "**Options**" tool allows the user to manipulate a live or stored image: CCW 90^{o} (rotate counter-clockwise 90^{o}), Rotate 180^{o}, CW 90^{o} (rotate clockwise 90^{o}), HistEq (perform histogram equalization for improved image contrast), B/W (convert image to monochrome image), Full Screen (maximize the size of the image by removing panels) and Clear List (will clear image storage).

7. The "**Annotate**" button enables the image to be annotated with text and graphics.

8. The "**Capture Video**" button allows the user to capture up to five minutes of video.

9. The **"Focus Control"** (located below "Case Details) has an "Auto" focus button and a toggle to optimize the focus.

28.6.2 Near Infrared Light Source

A. Check the infrared light source with the known bloodstain standard (bloodstain on black fabric) prior to examination of evidence. Turn on the white light source (up/down arrows on ML2-IR head). Set the camera filter to "III". Select "Live" and "Auto" exposure. Place the bloodstain standard under the ML2-IR head. An image of the standard should appear on the tablet screen. If needed, adjust the focus by using the "Auto" focus button on the "Focus Control".

B. Select the infrared light source on the ML2-IR head. Set the camera filter to "IIII". Select "Live" and "Auto" exposure. An image of the standard should appear on the tablet screen (blackish stain on a white background).

C. Record the date, sample, light source (infrared), ML2-IR, initials and result on the appropriate equipment log sheet.

28.6.3 Near Infrared Light Source: **Examination of Evidence**

A. Select the infrared light source on the ML2-IR head. Set the camera filter to "IIII". Select "Live" and "Auto" exposure. If needed, adjust the focus by using the "Auto" focus button on the "Focus Control". The ML2-IR infrared light source assists in the location of possible bloodstains by making the substrate color or pattern appear whitish, while possible bloodstains appear blackish. The infrared light source will not assist in the examination of all substrates.

B. Move the ML2-IR head over the evidence while viewing the image on the tablet.

28.6.4 Capturing and Image: Method A

A. Tap the "**Grab Image**" button. The captured image will be moved to the "CLC Grab" folder (**temporary storage**) and a thumbnail image will appear along the bottom of the screen.

B. After capturing the image with the infrared light source, change the light source to the white light (up/down button on ML2 head) and change the camera filter to "III" (be careful not to move the camera head). Optimize your image: adjust exposure and adjust focus and tap the "Grab Image" button.

C. Hold down on the thumbnail image (with the stylus) and the following options will appear: "delete", "delete all", "delete all but this image", "save", and "save all".
Warning: you will *not* be asked if you are sure that you would like to delete any or all images.

D. If you hold down on the thumbnail image store area (not on an image) you will be given the option to "Delete All" or "Save All". **Warning: you will *not* be asked if you would really like to delete all images.**

E. The images taken with the "Grab Image" button must be transferred to the thumb drive. To do this:
   a. Minimize the Crime-lite Cam software, open the "CLC Grab" folder, select "Select all" (top toolbar), select "Move to" (top toolbar), select "Choose Location", select "USB (D:)", add folder (if desired) and select "Move". The "CLC Grab" folder will be empty and all the images will be located on the thumb drive.
   b. Or use the "save all" option and save to thumb drive.

F. Before removing thumb drive from the "4 Port USB 2.0 HUB", select "^" (lower right corner on tablet screen), select the thumb drive image, select "Eject Ultra" and a message that is safe to remove hardware will appear.

G. Delete the thumbnail images after returning to the Crime-lite Cam software.

28.6.5 Capturing and Image: Method B

A. Tap the **"Capture Evidence"** button after optimizing image. Upon successfully capturing an image the following message will appear: The image was successfully saved to disk. The "Capture Evidence" button will store the image into the "Working Folder". Then transfer images from "Working Folder" to thumb drive.
Reminder: To use the "Capture Evidence" button, the "Device Settings" and "Case Details" **must** be completed.

B. Before removing thumb drive from the "4 Port USB 2.0 HUB", select "^" (lower right corner on tablet screen), select the thumb drive image, select "Eject Ultra" and a message that is safe to remove hardware will appear.

28.6.6 Blue and Blue-Green Light Sources: Examination of Evidence

A. Check the light source with the known stain standard (semen, saliva or urine) prior to examination of evidence. Place the stain standard under the ML2-IR head. With the room light off, the blue light on and wearing the yellow goggles or with

the blue-green light on and wearing orange googles the stain will fluoresce. Alternatively, the fluorescence can be observed without wearing the goggles by placing the cut-off filter plate (blue light with yellow filter or blue-green light with orange filter) securely on the top surface of the ML2-IR head and observing the fluorescence through the ML2-IR head.

B. Record the date, sample, light source (blue or blue-green), ML2-IR, initials and result on the appropriate equipment log sheet.

C. Move the ML2-IR head (blue light/yellow goggles or cut-off filter plate or blue-green light/orange goggles or cut-off filter plate) over the evidence to locate any fluorescent stains.

28.6.7 Blue and Blue-Green Light Sources: Capturing and Image

A. If using goggles and not the cut-off filter plate, securely place the appropriate cut-off filter plate on the top surface of the ML2-IR head and swing the camera into place. Select filter setting "III" for the camera filter.

B. View the image on the tablet. Select "Live" and "Auto" exposure. If needed, adjust the focus by using the "Auto" focus button on the "Focus Control".

C. See 28.9.4 and/or 28.9.5 (Capturing and Image) methods to capture an image.

28.6.8 Ultraviolet Light Source: Examination of Evidence

A. Check the light source with the known stain standard (bloodstain on denim fabric) prior to examination of evidence. Place the stain standard under the ML2-IR head. With the UV light source on, swing the camera into place with the filter setting "I" selected, and the UV Imaging Safety Plate securely on the top surface of the ML2-IR head and observe the standard image on the tablet.

B. Record the date, sample, light source, ML2-IR, initials and result on the appropriate equipment log sheet.

C. Move the ML2-IR head over the evidence to locate stains. Note: The camera filter setting can be adjusted to "II" depending on the fabric color/pattern.

D. See 28.9.4 and/or 28.9.5 (Capturing and Image) methods to capture an image.

E. If necessary, mark the location of the area of interest on the evidence.

28.6.9 Shutting Down the ML2-IR

A. Return to the Desktop by closing the software.

B. Check that all the images in the CLC Grab folder and the Working folder have been transferred to the thumb drive and deleted from these folders.

C. Turn off the tablet by pressing the button on the upper left corner and unplug.
D. Turn off the light source on the ML-2 head and unplug.

E. Clean surfaces of the ML2-IR and the stylus appropriately.

28.7 REFERENCES

A. H. Willard, L. Merritt Jr., J. Dean, F. Settle, Jr.; *Instrumental Methods of Analysis*, Chapter 8: "Fluorescence and Phosphorescence Spectrophotometry", pp 197-199, 7th edition, Wadsworth Publishing Co., 1988.
B. A. Farrar, G. Porter, A. Renshaw*; Detection of Latent Bloodstains Beneath Painted Surfaces Using Reflected Infrared Photography;* Journal of Forensic Sciences, September 2012, Vol. 57, No.5.
C. Crime-lite Cam User Manual (Software) v.1.2.1.721, February 2015, Foster + Freeman.
D. Training Powerpoint by Foster + Freeman, September 2018.
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F. GL-13 (General Evidence Handling).