Section J Vacuum Metal Deposition (VMD) Subsection 7

Name of Procedure:

Vacuum Metal Deposition (VMD)

Suggested Uses:

This process is used to develop latent impressions on low density polyethylene and other surfaces through vacuum coating and the deposition of thin metal films. This technique may be used on non-porous items such as plastic bags, plastic tarps, plastic wraps, plastic packaging materials, smooth leather, Styrofoam, glass, and various other substrates. Vacuum Metal Deposition is an extremely sensitive process which will detect latent print residue. This technique may also be used in conjunction with other processes to develop latent impressions which have been deposited on a surface for a lengthy period of time.

Equipment Needed to Perform Procedures:

A - Vacuum Metal Deposition Chamber

B - Source boats for metal evaporation

C - Magnetic work holders

D - Camera (35mm, 2 1/4, MP-4, CU5, TC III)

E - Rubber gloves and protective clothing

F - Dust or mist respirator - for cleaning only

G - Tweezers

Chemical(s) Needed for Preparation of Chemical Solution(s):

A - One (1) precut Gold filament

B - One (1) piece of Zinc or sufficient amount to allow adequate vaporization

Formula/Directions for Preparation of Chemical Solution(s):

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Not Applicable

Processing Procedures for Application to Item(s) of Evidence:

Note: Avoid placing items of evidence into the chamber which may explode or any container under pressure.

1. Open the chamber door which will bring the unit to atmospheric pressure.

    a. **Press "VENT"** and allow the chamber to vent (this may take 2 or 3 minutes).
    b. If the door will not open **do not force it**. Allow the chamber to complete venting before attempting to open the door.
    c. **Clean door seal (O-Ring in the door and chamber facing) with Alcohol**. This will ensure a good seal.

2. Carefully attach articles to work holder.

Note: Use black lift cards for test prints. White paper behind plastic bags will help with contrast during development. Solid objects need to be secured with fine wire or string.

3. Load evaporation sources with Gold and Zinc.

    a. Use the pre-prepared sources in the containers.
    b. Use tweezers to bend the Gold wire into a "V" and place into the middle of the source boat.
    c. Place ZINC into the source boats. Some Zinc may be present in the source boat, however, add one (1) piece of zinc into each source boat.

4. Turn off interior light . **Press "CYCLE".** Pump chamber down to a pressure of **2×10^{-4} to 6×10^{-4}** or lower.

Note : The following messages will appear: "ROUGHING", "PUMP DOWN" and then "FINE PUMPING". This process may take 20 minutes or longer. **Remain with the system until the "FINE PUMPING" message (9.0 x 10^{-4}) appears.**

Note: If the message "PUMP FAILURE" appears, **Press "RESET"** followed by **Press "START"** and **Press "CYCLE".** If the chamber is dirty or when processing dirty or contaminated items of evidence, it will take longer to pump down. If the appropriate pressure cannot be achieved within **one (1) hour** notify the Key operator.

5. When the pressure reaches **9 x 10^{-1} to 6 x 10^{-1}** melt the gold to a small ball:

Note: To prevent Gold from jumping out of the source boat, adhere to the following procedures:

a. Turn the "SOURCE VOLTAGE SWITCH" to "**LT**".
b. Turn the "SOURCE SELECTOR" to "**GOLD**".
c. Turn the "SOURCE CURRENT CONTROL" **clockwise** to approximately 4-6 until the GOLD melts to a small ball.
d. **Immediately** turn the "SOURCE CURRENT CONTROL" **counterclockwise** to **"0".**
e. Turn the "SOURCE VOLTAGE SWITCH" to "**0**" (off)**.**

6. Evaporate Gold

a. **When the indicator reaches 2 x 10^{-4} to 6 x 10^{-4} or lower, turn the "SOURCE VOLTAGE SWITCH" to "LT".**
b. Turn the "SOURCE SELECTOR" to "GOLD".
c. Turn the "SOURCE CURRENT CONTROL" **slowly clockwise** to "**6**"," **7**" and "**8**" then continue turning to **"10"** quickly.
d. Leave on "10" for approximately 10 seconds.
e. **Immediately** turn the "SOURCE CURRENT CONTROL" **counterclockwise** to **"0".**

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7. Evaporate ZINC

   a. Turn the Chamber Lights **ON**.
   b. Turn the "SOURCE SELECTOR" to "ZINC".
   c. Turn the "SOURCE CURRENT CONTROL" **slowly clockwise** to "3 ½" to "4". Do not go higher than 5.
   d. **Watch the evidence carefully** for development of latent prints.
   e. When latent print development is satisfactory, **immediately** turn the "SOURCE CURRENT CONTROL" **counterclockwise** to **"0".**

8. Decontaminate gold source boat.

   a. Turn the "SOURCE SELECTOR" to "GOLD".
   b. Turn the "SOURCE CURRENT CONTROL" **clockwise** to **"10"** quickly.
   c. Leave on **"10"** for approximately **2-3 seconds**.
   d. **Immediately** turn the "SOURCE CURRENT CONTROL" **counterclockwise** to **"0".**
   e. Turn the "SOURCE VOLTAGE SWITCH" to "0" (off).

9. Bring system up to atmospheric pressure and open door.

   a. **Press "VENT"** and allow the chamber to vent (this may take 2 or 3 minutes).
   b. Open door. If the door will not open **do not force it**. Allow the chamber to complete venting before attempting to open the door.

10. Remove article. Repeat from STEP 2 to STEP 9 for next article or to continue processing the same article.

11. To shut down system **Close door** and **Press "STOP".** Leave water running.

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Steps To Preserve Developed Impressions:

The most appropriate methods in preserving developed impressions is through photography, using the proper techniques (See Photographic Equipment/Procedures), and electronic recording (See Image Processing). Developed impressions should be photographed as soon as possible as the impressions may fade over a short period of time. The developed impressions may also be lifted with regular lift tape to preserve the image. The impressions will be reversed in color on most occasions and this must be considered during comparisons.

Safety Concerns:

Wear laboratory coats, heavy duty gloves and eye protection when cleaning with Acetic Acid or Isopropyl Alcohol.

Wear laboratory coats and non-porous gloves when undertaking Vacuum Metal Deposition.

Never put closed containers in the vacuum system as they may explode under vacuum; *(e.g. aerosol cans, batteries, bottles with caps, sealed drink cans or bottles etc).* Manufacturers have advised that they believe that it is safe to treat conventional types of ammunition including shotgun cartridges. If in doubt contact an expert on ammunition for advice.

Remove all residual liquids and solids before treating containers.

Wash hands contaminated with Zinc dust before handling food, drink or cigarettes.

Remove loose Zinc dust and flakes from the chamber with a vacuum cleaner daily. Wear a dust respirator during any cleaning processes which are likely to generate dust. Seal contaminated aluminum foil in ziploc plastic bags for safe disposal after removal from the chamber.

Storage and Location of Chemicals and Solutions:

Store the Gold and Zinc in a cool dry place at all times.

Shelf Life:

Gold and Zinc - Indefinite if stored properly.

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Other Information:

Vacuum means an environment in which the pressure is below normal atmospheric pressure.

Vacuum Metal Deposition has not been found to be successful on coarse papers, course fabrics or heavily contaminated surfaces.

The water supply to the unit should remain constant at all times.

Vacuum Metal Deposition should be used in the normal sequence of processing after cyanoacrylate ester. However, consideration must be given to the particular types of evidence which this technique is most appropriate.

This technique will interfere with document, serological and trace evidence examinations. All samples and examinations for other forensic disciplines should be conducted prior to using Vacuum Metal Deposition.

It may be beneficial to retreat an item of evidence to sufficiently develop latent impressions.

Multiple items of evidence may reveal different rates of development and it is important to view the impressions to avoid overdevelopment.

In some cases the use of a laser or alternate light source will enhance the impressions developed with Vacuum Metal Deposition.