

**Section J - Subsection 3**

**Physical Developer**

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**Name of Procedure:**

Physical Developer

**Suggested Uses:**

Physical Developer is a silver-based aqueous reagent which reacts to the components of sweat to form a gray silver deposit. This process is normally used on paper but may also be used on other porous materials. It is usually used after treatment with ninhydrin and/or other ninhydrin analogs and is an effective reagent for developing latent impressions on wet papers.

**Equipment Needed to Perform Procedures:**

- A - Protective clothing and rubber gloves
- B - Magnetic stirrer, magnetic follower and magnetic retriever
- C - Five (5) glass beakers (three [3] 2000 ml and two [2] 1000 ml)
- D - Four (4) glass trays
- E - One (1) dark shatterproof container (one [1] gallon)
- F - Two (2) glass measuring cylinders (one [1] 1000 ml and one [1] 50 ml)
- G - Forceps (type which will not leave indented impressions)
- H - Camera (35 mm, 2 1/4, MP-4, CU5, TC III )

**Chemicals Needed For Preparation of Chemical Solution(s):**

- A - Eighty (80) grams of Ammonium Ferrous Sulphate
- B - Twenty (20) grams of Citric Acid
- C - Four (4) grams of n-Dodecylamine Acetate
- D - Thirty (30) grams of Ferric Nitrate
- E - Twenty-five (25) grams of Maleic Acid
- F - Ten (10) grams of Silver Nitrate
- G - Three (3) grams of Synperonic N

H - Distilled Water

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

Physical Developer consists of a working solution which is made from a stock detergent solution, a redox solution, a Maleic Acid solution and other chemicals. The distilled water used in preparing the solutions must be between 17 and 23 degrees Celsius ( 62.6 and 73.4 degrees Fahrenheit). The glassware utilized in this technique must be cleaned thoroughly. Wipe all internal surfaces of the beakers with paper towels under cold tap water and rinse three (3) times with distilled water before use. After completion of all processes, wash beakers and trays with tap water and dry with a clean cloth or paper tissue. Stubborn stains may be removed with a mild detergent (never use an abrasive cleaner) and rinse with cold tap water for ten (10) minutes to remove detergent.

**Solution #1 - Maleic Acid:**

1. Place one-thousand (1000) ml of distilled water in a clean two-thousand (2000) ml glass beaker with a magnetic stirrer.
2. Add twenty-five (25) grams of Maleic Acid to the distilled water and stir to ensure the solution is thoroughly mixed. Stir until all the Maleic Acid is dissolved which will produce a colorless solution.
3. Transfer the solution to a clean dark shatterproof container until needed.

**Note:** It may be more convenient to make a larger volume of the Maleic Acid solution and store for future use (Unused Maleic Acid may be stored indefinitely).

**Solution #2 - Redox:**

1. Place one-thousand (1000) ml of distilled water in a clean two-thousand (2000) ml glass beaker with a magnetic stirrer.
2. Weigh out the following chemicals and add them to the distilled water in the order given with continual stirring:
  - a. Thirty (30) grams of Ferric Nitrate;
  - b. Eighty (80) grams of Ammonium Ferrous Sulphate; and
  - c. Twenty (20) grams of Citric Acid.

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Stir until all the solids have been dissolved for an additional five (5) minutes.

3. Transfer the solution to a clean dark shatterproof container until needed.

**Note:** It may be more convenient to make a larger volume of the Redox solution and store for future use (Unused Redox solutions may be stored indefinitely).

**Solution #3 - Stock Detergent:**

1. Place one-thousand (1000) ml of distilled water in a clean two-thousand (2000) ml glass beaker with a magnetic stirrer.
2. Add four (4) grams of n-Dodecylamine Acetate to the distilled water with continual stirring.
3. Add four (4) ml of Synperonic N to the solution and continue to stir for at least thirty (30) minutes. A slightly colorless stock solution will be produced.
4. Transfer the solution to a clean dark shatterproof container until needed.

**Note:** The Stock Detergent solution must not be used until the solution is at least twenty-four (24) hours old, thus ensuring that all solid matter has been dissolved. The solution may be mixed in larger quantities and stored for future use (Unused solutions may be stored up to one (1) year).

**Solution #4 - Silver Nitrate:**

1. Place five-hundred (500) ml of distilled water in a clean one-thousand (1000) ml glass beaker with a magnetic stirrer.
2. Add one-hundred (100) grams of Silver Nitrate to the distilled water and stir to ensure the solution is thoroughly mixed. Stir for approximately ten (10) minutes.
3. Place the Silver Nitrate solution in a dark place until needed.
4. Examine the Silver Nitrate solution to ensure that all the crystals have been dissolved (It may be necessary to stir the solution for an additional length of time to dissolve all crystals). Silver Nitrate solutions may be stored up to one (1) year. It is essential that the solutions be stored in a dark shatterproof container away for direct sunlight.

**Working Solution:**

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**Note:** The working solution may be mixed and stored in a dark shatterproof container at room temperature for several weeks. It is suggested that the working solution be mixed as needed for use with Physical Developer. A white sediment may appear which will not affect performance of the solution.

**The following solutions must be mixed in the order listed.**

1. Place one-thousand (1000) ml of Solution # 2 (Redox) in a large clean glass beaker with a magnetic stirrer.
2. Add forty (40) ml of Solution #3 (Stock Detergent) and fifty (50) ml of Solution #4 (Silver Nitrate) to the solution with continual stirring.
3. Continue to stir for three (3) to five (5) minutes.

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

When processing items of evidence, four (4) glass processing trays will be needed to complete the procedure. The distilled water tray may be used for the initial and final step. The distilled water should be replaced if any heavy contamination occurs while processing numerous items.

1. Place a sufficient amount of each of the following solutions in the appropriate glass tray to completely submerge the item of evidence.

Tray #1 - Distilled water

- a. Place the item(s) in tray #1 (distilled water) for approximately five (5) to ten (10) minutes. This will remove the previously applied chemicals and dirt which may be on the item.
- b. Periodically agitate the tray during this step.

Tray #2 - Maleic Acid

- a. Place the tray on an agitator while processing.
- b. Place the item(s) in tray #2 (Maleic Acid) for approximately five (5) to ten (10) minutes. Ensure that there are no bubbles noted on the item(s) prior to continuing.

Tray #3 - Working Solution:

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- a. Place the tray on an agitator while processing.
- b. Place the item(s) in tray #3 (Working Solution) for approximately five (5) to fifteen (15) minutes.
- c. Inspect the item(s) periodically to prevent overdevelopment of the impressions . The amount of time necessary to process items of evidence will vary depending on the number and size of the item.

Tray #4 - Rinse tray

- a. The use of running distilled water is preferred: however, tap water may be used instead of distilled water in this tray.
  - b. Allow the item to remain in the distilled water for approximately three (3) to five (5) minutes. This will prevent further development of the impressions and remove unnecessary solutions from the item.
2. Remove the item from the working solution and allow the item to completely air-dry prior to proceeding. A hot-air dryer may be utilized to expedite the drying process; however, do not use a hot iron as this may destroy the impressions. The developed impressions may be more visible after the drying process is completed.
  3. Low contrast impressions may be improved by retreating the item(s) with Physical Developer starting with the working solution. In the retreating process, it is not necessary to use the Maleic Acid solution. Visible impressions should always be photographed prior to retreating as there is the possibility they will be destroyed or over-development may occur.

**Steps to Preserve Developed Impressions:**

The most appropriate methods in preserving developed impressions is through photography, using the appropriate techniques (See Photographic Equipment/Procedures), and electronic recording (See Image Processing).

In some cases the photographic contrast of developed impressions may be improved by Florescent Examination. The background material may fluoresce and the developed impressions will absorb the illuminating light creating a negative image which will assist in photographing the impression.

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**Safety Concerns:**

Silver Nitrate and the solutions containing this chemical are corrosive and toxic and therefore, should be handled with extreme care. Always wear rubber gloves and avoid ingestion or inhalation. The solutions will stain clothing and skin and will appear as black in color and remain on skin for several hours after contact. Protective gloves, eye goggles and protective clothing should be worn at all times.

**Storage and Location of Chemicals and Solutions:**

Ammonium Ferrous Sulphate, Citric Acid, n-Dodecylamine Acetate, Ferric Nitrate, Maleic Acid, Silver Nitrate and Synperonic N should be stored in their original shipping containers until needed.

Maleic Acid , Stock Detergent and Working solutions should be stored in dark shatterproof containers.

It is recommended that Working Solutions be mixed as needed.

**Shelf Life:**

Ammonium Ferrous Sulphate, Citric Acid, n-Dodecylamine Acetate, Ferric Nitrate, Maleic Acid, Silver Nitrate and Synperonic N - Indefinite if stored properly.

Solution #1 (Maleic Acid) and Solution #2 (Redox) - Indefinite.

Solution #3 (Stock /detergent) and Solution #4 (Silver Nitrate) - up to one (1) year.

Working solutions - two (2) weeks (It is recommended that this solution be mixed as needed)

**Other Information:**

Careful preparation of Physical Developer is essential with all measurements as exact as possible and glassware as clean as possible.

Long development times will indicate that the Silver Nitrate concentration has weakened and the solution(s) should be discarded and new solutions mixed. If new solutions are mixtured, be sure to thoroughly clean the trays and beaker prior to using the new solutions.

Solutions used in this technique should not be reused or placed into a unused solution containers.

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Plastic forceps without serrated edges should be used to handle or transfer item(s) from tray to tray.

Care should be taken to avoid any unnecessary creasing or rough edges on the item(s) which may cause unwanted deposits of Silver.

Physical Developer cannot be used prior to ninhydrin or one of the ninhydrin analogs in the sequence of processing.

Physical Developer may be followed by Sodium Hypochlorite (Bleach solution) to lighten the background and darken the developed impression (See Sodium Hypochlorite Procedures).