# What is the Cyanotype Process?

The Cyanotype process, originally created by Sir John Herschel in 1842, is also known as a "blueprint" process. The final print is characteristically blue in color. The print is typically has a short-scale tonal range, making it somewhat "contrasty." The cyanotype print is also known as a "non-silver" process, since it employs ferric (iron) salts for its photosensitivity, from a combination of two solutions, one containing ferric ammonium citrate and the other solution containing potassium ferricyanide. Combining these complete solutions in equal parts creates a sensitizing solution which is then brushed or painted onto the surface of a substrate like cloth or hot-press watercolor paper.

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# Basic Chemistry of Cyanotyping (1)

When iron ( Fe, from the Latin "Ferrum") is chemically combined with other elements, its atoms acquire a positive charge by transferring two or three of their orbiting negative electrons onto atoms of other elements. So each iron atom ends up in one of two states: "ferrous" iron - also called iron (II) or $Fe^{2+}$ for short, "ferric" iron - also called iron (III) or $Fe^{3+}$. This number 2+ or 3+ is called the oxidation state of the iron, and signifies the positive electric charge that the iron atom has acquired in the reaction.

Oxidation makes an atom or molecule more positive (or less negative) in the electrical sense. So when iron forms compounds, it is oxidized. Reduction is the converse: making an atom or molecule less positive (or more negative). e.g. oxygen gas, which consists of molecules containing two linked atoms of oxygen, $O_2$, is reduced to form oxides, which contain the $O^{2-}$ ion. Both processes involve the transfer of electrons. Oxidation is the removal of electrons while reduction is their addition.

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# Basic Chemistry of Cyanotyping (2)

The Cyanotype is part of a group of processes that include the palladium print, the platinotype and the kallitype.

Iron-salt processes basically work like this: All ferric (iron III) salts, when combined with organic substances, become sensitive to light. A commonly used mixture is ferric ammonium citrate and potassium ferricyanide. Exposure to ultraviolet light breaks down the iron compound by oxidation, thereby releasing carbon in the form of carbonic acid. The exposed print is then immersed in water, causing a reaction between the new compound (peroxide iron salt) and the potassium ferricyanide. A deep-blue compound, ferric ferrocyanide or Iron (III) Hexacyanoferrate (II), is formed.

**For a detailed explanation of the chemistry of Cyanotyping see Mike Ware's book: Cyanotype The history, science and art of photographic printing in Prussian blue ISBN 1 900747 07 3 published by the Science Museum, London, for the Nation Museum of Photography, Film and Television.**

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# Cyanotype Recipe (1)

**Basic formula, lasts 4-6 weeks**

| **Solution A:** | **Solution B:** |
|---|---|
| 50 g Ferric Ammonium Citrate | 35 g Potassium Ferricyanide |
| 250 ml distilled $H_20$ | 250 ml distilled $H_20$ |

Mix equal portions of A and B just before use.

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# Cyanotype recipe (2)

**Single solution formula:**
**More sensitive and stable mixture but only lasts 4 hours.**

- 1.25 grams Oxalic acid (TOXIC to even skin)
- 33.7 grams Ferric Ammonium Citrate
- 11.2 grams Potassium Ferricyanide
- 0.25 grams Ammonium Dichromate
- 250 ml distilled $H_20$

Mix all together just before use.

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# Cyanotype recipe (3)

**Modified Basic Solution**
**A more sensitive and stable recipe that lasts 4-6 months.**
**This is the one I use.**

| **Solution A** | **Solution B** |
|---|---|
| 1.25 g Oxalic Acid | 1.25 g Oxalic Acid |
| 67.5 g Ferric Ammonium Citrate | 22.5 g Potassium Ferricyanide |
| 250 ml distilled $H_20$ | 0.5 g Ammonium Dichromate |
| | 250 ml distilled $H_20$ |

Mix equal portions of A and B just before use.

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# Cyanotype recipe (4)

**Mike Ware's New Cyanotype Recipe**

**Notes:**
1: The following procedure should be carried out under a red safety lamp.
**2: This is complicated and time consuming compared to the Modified Basic Solution. This recipe is VERY light sensitive with exposures less than one minute in late winter sun! This is too sensitive for students.**

**Chemicals**
10 g Potassium Ferricyanide
30 g of Ammonium Iron (III) Oxalate
0.5 ml 25% Ammonium Dichromate solution
distilled water

**Procedure**
1) Using a mortar and pestle, finely powder 10 g Potassium Ferricyanide until no red crystals remain. **Wear a dust mask to avoid inhalation of the toxic powder.**

2) Heat 30 ml distilled water to 50° C and dissolve in it 30 g of Ammonium Iron (III) Oxalate.

3) Add 0.5 ml 25% Ammonium Dichromate solution to the above solution and mix.

4) While the solution is still hot add 10 g of powdered Potassium Ferricyanide in small proportions while stirring vigorously. Green crystals should begin to appear. Set the solution aside for an hour to crystallize.

5) Separate most of the liquid for the green crystals by filtration. The green solid, Potassium Iron (III) Oxalate, should be disposed of safely. The volume of the collected solution is about 30 ml.

6) Make up the olive-yellow colored solution with distilled water to a final volume of 100 ml.

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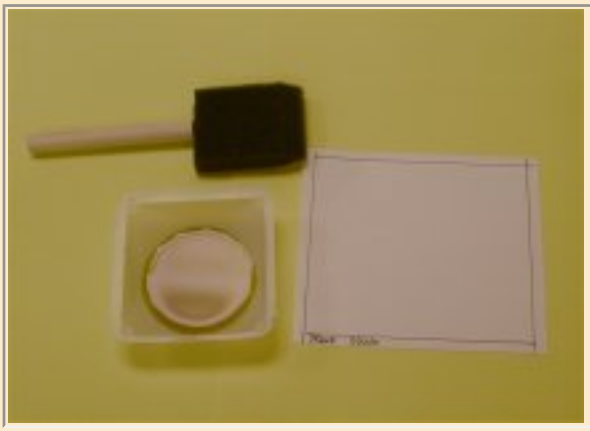
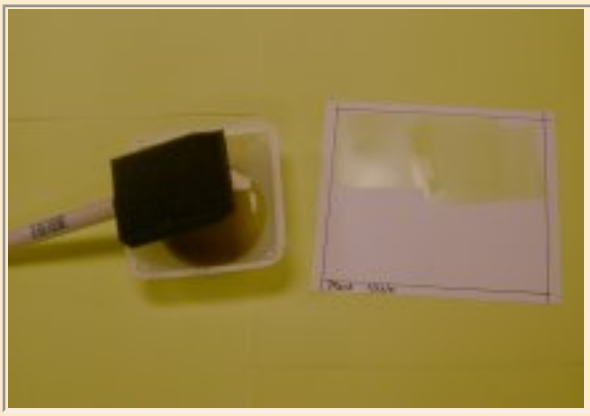
# Sensitizing Procedures

1) Turn off the lights and close the shades. You can use red safe lights if needed. Apply solution onto desired surface

| | |
|---|---|
|  | A foam brush and a small container with Cyanotyping chemicals. |
|  | Apply solution onto desired surface. Work from the edges toward the center of the surface to prevent pooling at the edges. |
|  | Allow the formula to soak into your cloth or surface. It is normal for curling to occur |

2) Hang up or place on a plastic screen, and allow drying thoroughly. Do not expose the emulsion until it is completely dry. As well, do not wait too long AFTER it has dried .(Note: I have had acceptable results with sensitized paper stored in the dark for several weeks!)

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# Printing Procedure

| | |
|---|---|
| 1) Place the sensitized paper yellow side up on a piece of Plexiglas. |  |
| 2) Place the negative on the sensitized paper. |  |
| 3) Cover the frame with the other piece of Plexiglas and hold together with clips. (Note: Clip arms will block the light on the print!) |  |

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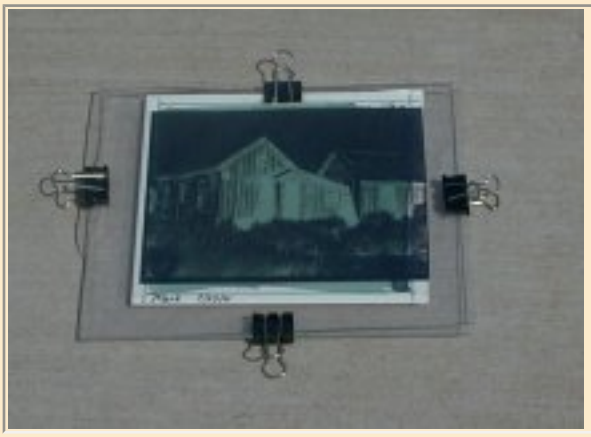
# Exposure Procedures

Exposure times may vary due to thickness of transparency and the degree of contrast/saturation you desire. General guidelines for exposure are: (Sunlight) 1- 25 minutes; (Open shade) 30-60 minutes; (UV florescent) 10-20 minutes; (High intensity arc lamps) 5-15 minutes; (Mercury vapor or pulse-xenon lamps) 3-10 minutes; (500 watt photoflood or sunlamps) 20-40 minutes. Exposures onto cloth or other low-reflective surfaces: add 50% exposure time.

| | |
|---|---|
| 1) Take print outside into the sunlight. Print will begin to change colors as the UV light exposes the print.<br><br>Use a stop watch to monitor exposure time. |  |
| 2) After 1 - 10 minutes the frame looks "solarized" indicating the end of the process. ( Note: this is very forgiving for over exposure!) |  |

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# Developing Procedure

1) Take the print inside and separate the frame.

| | |
|---|---|
| Your Cyanotype will look like the picture here. Develop face down in running water for 10-15 minutes (possibly longer if cloth). Wash until COMPLETELY clear of "running" colors. |  |

2) Soak print in a solution of 20 ml $H_2O_2$ (3%) and 250 ml of distilled $H_20$ to increase the contrast and bring out the deep blues. You can use more or less $H_2O_2$ depending on how fast you want to deepen the color.

3) Hang up or place on plastic screen. The blue color will darken slightly with drying.

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# Toning Procedures

## Two-Tray Brown-Black Toner for Cyanotype Using $NH_4OH$

| | |
|---|---|
| 1) Soak the print in a solution of 30 ml $NH_4OH$ in 250 ml of distilled $H_2O$ until the print in almost lost |  |
| 2) Rinse print thoroughly | |
| 3) Soak the print in a solution of 1 tablespoon of tannic acid dissolved in 1000 ml of distilled $H_2O$ until the desired color appears, then rinse. |  |

Note: These are VERY flexible measurements. Many formulas say stronger. Coffee or tea can replace the tannic acid.

## Two-Tray Brown-Black Toner for Cyanotype using Sodium Bicarbonate: slower but easier to handle

Solution A: 1 teaspoon tannic acid in1000 ml of $H_2O$.

Solution B.: 2 teaspoons sodium bicarbonate in 1000 ml $H_2O$.

Note: These are VERY flexible measurements. Many formulas say stronger. Coffee or tea can replace the tannic acid.

1) Start by immersing the print (pre-soaked or dry, but not right out of wash water from being made - has to dry/harden first) in solution A, tannic acid. Take two minutes as your base time if you want to be quantitatively authoritative; but this is one of the ones we do by feel.

2) Now rinse in clear water to preserve your solution B

3) Bathe print briefly (less than minute) in B and rinse again. Now BACK into A, which is where the color happens. Watch carefully and if you want a split tone, snatch the print out BEFORE it gets to the color you want because, just as in ferricyanide bleaching, chemical remains in the paper and action continues after it's in the rinse bath.

4) Strictly speaking, to save lots of changing of water, you need 3 rinse trays -- one for after the first tannic bath; one for after the first carbonate bath, and one for the finished print.

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# Producing the Negative

1) Select a positive image from a scanned photo or negative, digital camera image or stock digital images.

2) Size the image to the desired printable size in a paint program. I use 5" width so it groups nicely on overhead transparency film.

3) Make a blank image that is the size of an overhead transparency film (8 1/2 by 11 inches). Check the background set to transparency since a white background will become black wasting ink / toner.

4) Copy the image(s) into the new blank picture. You might need to rotate the image to fit. SAVE YOUR IMAGE.

5) Convert the NEW IMAGE to a negative.

6) Increase the resolution of the NEW IMAGE by resizing to the same size but change the resolution to you printer resolution (600 dpi for laser printers). SAVE YOUR IMAGE.
NOTE: this can take time and produces a large image.

7) Print out on a laser printer with overhead transparency film.
NOTE: You can make a paper negative by printing the negative on standard paper then spraying the paper with "Pam" or soaking it in vegetable oil.

8) Separate your negatives.

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# Sources, Links and Suppliers

**Much of the information I have presented comes from:**
Mike Ware's web page and book: Cyanotype The history, science and art of photographic printing in Prussian blue ISBN 1 900747 07 3. Published by the Science Museum, London, for the Nation Museum of Photography, Film and Television.

Dan Burkholder's book: Making Digital Negatives for Contact Printing 2nd ed ISBN 0-9649638-6-8. Published by Blade Iris Press

**Chemicals and Paper Supplies**
Photographer's Formulary Inc. Crane's 90# Cover Paper, Natural White, Wove
photo-eye books & prints Source for the cited books.
Blueprints-Printables Home Page Pre-sensitized Cyanotype cloth.

**Cyanotyping Links**
Mike Ware's Alternative Photography Homepage
Cyanotype
A History of Photography
Alternative Processes by Astrid Bieber Photography
Alternative Processes Cyanotypes
Cyanotypes.com Alternative Photography
Dan Burkholder Photographer, Artist and Platinum Printer
The Alternative Photographic Process FAQ
True Blue (cyanotype)

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