



Irving Penn's Platinum-Palladium Prints

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I began to love what occurs when you coat good paper by hand with these remarkable metals.

— Irving Penn, 1977

Figure 1. Irving Penn, *Irving Penn: In a Cracked Mirror*, New York, 1986. Platinum-palladium print on Rives paper mounted to aluminum, printed 1990, 49.5 × 49.5 cm. Courtesy and © The Irving Penn Foundation.

The photographer Irving Penn (1917–2009) began his pursuit of platinum-palladium printing after working for more than twenty years as a photographer, primarily for *Vogue* magazine. Hired in 1943 by the publisher's newly appointed art director Alexander Liberman, Penn worked with the “economy of a graphic artist” and “motivation of a journalist” as he made striking fashion, portrait, and still-life photographs for the then bimonthly magazine.¹ In the first two of his seven decades at *Vogue*, Penn did not consider his photographs to be art objects. Rather, he viewed the “end product of his efforts” as “the printed page, not the photographic print.”² Coincidentally, his frustration with the limitations of the reproduction process paralleled a “gradual disenchantment” with commercial photographic printing materials, fueling his growing interest in the “print as object” and his discovery of self-prepared platinum photographs (fig. 1).³

The platinum-palladium printing process as Penn would practice it began to evolve in the early 1960s. Guided by the platinum and palladium formulas of Carroll Bernard Neblette (1901–1972), Paul L. Anderson (1880–1956), and Louis Philippe Clerc (1875–1959),⁴ he tested a vast array of materials and processes, recording his experiments with scientific precision in notebooks and files that are now held in the Irving Penn Archives at the Art Institute of Chicago.⁵ His printing method ultimately involved

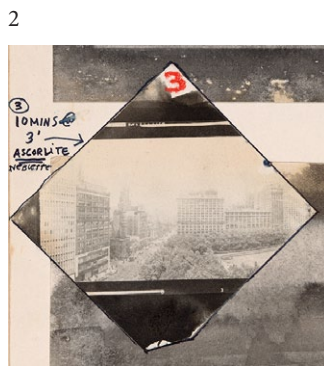
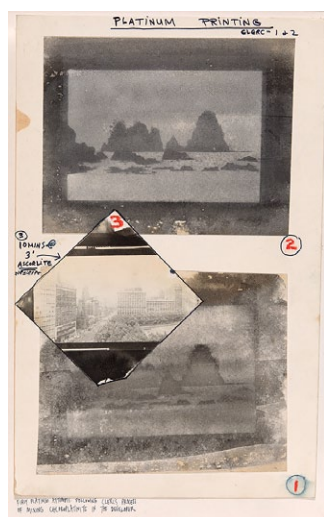
a complex and labor-intensive system of pin-registered negatives, paper laminated to aluminum sheets, and multiple sensitizing, exposing, and processing steps to realize a single luminous platinum-palladium print. These procedures are described in detail below, following a brief history of Penn's evolving interest in platinum and palladium printing and a description of his laboratories.

Penn's Early Trials

Intrigued by the promise of controlling the aesthetic results of his prints by preparing his own sensitized papers, Penn was determined to explore the possibilities offered by the platinum process.⁶ His curiosity about nineteenth-century printing processes was triggered during a trip to Rochester, New York, in the spring of 1963, when he visited the George Eastman House (now the George Eastman Museum).⁷ Penn was “just staggered by the prints made by the old photographers,” declaring, “they had a love for [the] print, and that was the end for them, there was nothing else.”⁸ Roughly a year later, in June 1964, he made his first platinum experiments. The key early test print was a view from his 80 West 40th Street studio, overlooking New York City's Bryant Park, made according

Figure 2. Irving Penn, [*Seascape* and *View from His 80 West 40th Street Studio, Overlooking New York City's Bryant Park*], both 1964. Platinum-palladium contact prints from 4 × 5 in. and 6 × 11 cm negatives, printed 1964, 27.8 × 17.7 cm. From an album page, c. 1965. The Art Institute of Chicago, Gift of Irving Penn, 2004.448. © The Irving Penn Foundation. Penn labeled the prints 1, 2, and 3. The inscription at top right, “Clerc 1 + 2,” refers to Penn's first two platinum test prints of the image, *Seascape*, following L. P. Clerc's process.

2a. Detail. Irving Penn, [*View from His 80 West 40th Street Studio, Overlooking New York City's Bryant Park*], 1964. Platinum print with the annotation, “3,” indicating that this is the third test print. It was sensitized according to a formula published by C. B. Neblette and exposed for 10 minutes at a distance of 3 feet from a pulsed xenon arc printing lamp.



2a



Figure 3. Irving Penn, *Cigarette No. 98*, New York, 1972. Platinum-palladium print on Rives paper mounted to aluminum, printed 1974, 58.9 × 43.2 cm. Courtesy and © The Irving Penn Foundation.

to formulas published by Neblette (fig. 2).⁹ These early trials inspired Penn to explore and ultimately master the platinum-palladium process. A self-described “victim of a printmaking obsession,”¹⁰ he spent years refining his technique, working from camera negatives previously printed only in gelatin silver, before arriving at his precision-made platinum-palladium prints in 1967.¹¹ Seeing the “potential of the print as inspiration for pictures themselves,”¹² Penn began photographing specifically for the platinum process in 1972, with his series of discarded cigarette and cigar stubs serving as the first subjects (fig. 3). His achievements in the process remained largely out of public view until 1975, when the first two exhibitions of his platinum-palladium prints opened that year.¹³

Throughout these formative years, Penn experimented with a variety of combinations of papers and sensitizer formulas, but he found that a single coating of sensitizer did not produce the intense and detailed shadows or subtle highlights he knew his camera originals could yield. He recounted his experience to the National Gallery of Art curator Sarah Greenough, who explained, “As he looked at the first platinum print he had ever made, he realized ‘in a flash’ that he needed to coat, expose, and develop his print multiple times in order to achieve the richness and

Figure 4. Irving Penn, *Sitting Man with Pink Face*, New Guinea, 1970. Platinum-palladium print on Rives paper mounted on aluminum, printed 1979, 52.4 × 49.2 cm. National Gallery of Art, Gift of Irving Penn, 2002.119.75. © The Irving Penn Foundation. Note the exposed aluminum strip along the top edge, with perforations that correspond to the register strips used to position the film during exposure.

complexity he desired.”¹⁴ But to do so would require a dimensionally stable printing surface that would hold its shape through repeated coating, printing, and processing steps. He also recognized that precise registration of the negatives at each step of the multiple-printing process was essential to achieving the sharp, vibrant image quality he pursued, with both strong and nuanced tones. Drawing on his experience with the registration methodology used to make separation films for offset lithography and the dye transfer process,¹⁵ Penn devised an elaborate printing system that involved paper-laminated aluminum sheets, which he called “plates,” enlarged negative sets, and pin registration equipment. One fine example of this process is his platinum-palladium print, *Sitting Man with Pink Face*, which is used throughout this essay to illustrate his complex printing method (fig. 4).

Penn’s Laboratories

Soon after his first tests in 1964, Penn designed and built a laboratory for making platinum-palladium prints in a barn that formerly served as horse stables on the family’s farm in Huntington, Long Island. More than a year was spent constructing a two-level laboratory with custom-built epoxy-coated worktables, drying cabinet, and processing sink. Penn also assembled the necessary equipment: xenon arc plate burners, vacuum easels and frames, and a used stainless steel basin from a decommissioned battleship that he purchased in the Bowery.¹⁶ Upon completion of the facility, known as “Lab A,” in the



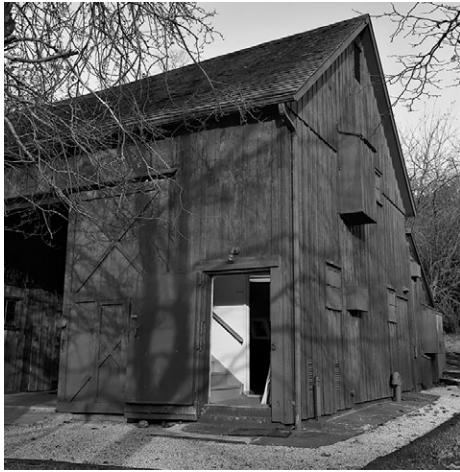


Figure 5. Lab A, c. 1986, where sensitizing, exposing, and chemical processing were performed. © The Irving Penn Foundation.



Figure 6. Lab B, c. 1986, where preparation of plates and enlarged films, deacidification, and drying and finishing prints took place. © The Irving Penn Foundation.



7a



7b

Figure 7. The coating room in Lab A, c. 1986, where chemicals were stored, mixed, and applied to the prepared plates. A plate with Penn's 1951 photograph, *Scalder, Shaver, and Singer*, rests on the counter against the wall. © The Irving Penn Foundation.

7a. The drying cabinet at the left, with sensitizing brushes hanging on the wall at the right.

7b. The chemical storage cabinet above the coating counter.

summer of 1965,¹⁷ Penn's work in the platinum-palladium process was centered here for the next thirty-five years.

Lab A consists of four rooms on two floors where the sensitizing, exposing, and processing of all prints were performed (fig. 5). In the summer of 1972 Penn added a second workspace, "Lab B," in a one-time sheep barn on the property, where activities that served as bookends to those in Lab A took place, including preparation of plates for sensitizing and printing, and postprocessing procedures (fig. 6).¹⁸

During his time as a practitioner of the platinum-palladium process, Penn maintained studios in Manhattan—at 80 West 40th Street until 1973, then at 89 Fifth Avenue from 1982 to 2009—where he photographed during the week and reserved weekends and holidays for printmaking in his Huntington labs. Studio assistants participated at each stage to help expedite his laborious printing process.

Although Lab B was dismantled after Penn's death in

2009, Lab A remains much as it was when Penn made his platinum-palladium prints, its preservation a direct result of ongoing care and efforts of his family.

Lab A: Sensitizing, Exposing, and Chemical Processing

In Lab A, the first room one enters is the coating room, where chemicals were stored and preparation and coating of platinum-palladium sensitizers took place (fig. 7).¹⁹ The sensitized plates were dried in a cabinet equipped with radiant heat but without a means to control humidity.

Adjacent to the coating room is the processing room, where prints were developed, cleared, and washed (fig. 8).



Figure 8. The processing room in Lab A, c. 1986. In the lower left corner the development tray rests on a counter. On the right is the epoxy-coated wooden sink in which prints were cleared and washed. In the center is a doorway opening into one of the plate exposing rooms. © The Irving Penn Foundation.



Figure 9. One of the plate exposing rooms in Lab A, c. 1986, showing a 4000 watt pulsed xenon arc printing lamp at left and vacuum frame. A box fan was used to reduce heat buildup of the vacuum frame glass. The sensitized plate was placed on the rubber platen, the film positioned on the plate's register strip, the glass closed, and a vacuum drawn to create perfect contact. The vacuum frame was then rotated into a vertical position for exposure to the light of the xenon arc lamp. © The Irving Penn Foundation.

Exposures were made in one of two rooms equipped with Ascorlux pulsed xenon arc printing lamps (both 4000 and 8000 watts)²⁰ designed for graphic arts applications (fig. 9). Penn extolled the quality of these point-light source units because they ensured maximum sharpness of the negatives' film grain while providing "an absolutely consistent light, day or night, with a good deal of control of intensity."²¹

Lab B: Plate Preparation and Finishing

Three large rooms constituted Lab B. One room was used to prepare the aluminum support sheets and mount the paper to the aluminum to form the plates. This area was also used for drying unmounted paper prints. Deacidification took place in a second room, which also housed the 4 × 5 inch enlarger used to project camera originals to make enlarged negatives and interpositives. The third room was used to store the supplies required for platemaking and finishing, and for drying the finished plates.

Mounting Printing Paper to Aluminum Sheets

Among the most labor-intensive operations of Penn's long and involved platinum-palladium process was the preparation of plates for printing. Penn's mounting system, with its rigid aluminum support that provided the printing substrate's dimensional stability, was critical for the pin registration he used to print his enlarged negatives.

Penn began with lightly sanded 18- or 20-gauge aluminum support sheets. He carefully perforated the sanded sheets with a series of holes alongside one edge using no. 7 punch and dies from the Whitney Metal Tool Company. Then he scrubbed the punched sheets with detergent and



Figure 10. Lab B's film exposing and plate-making room, c. 1986. A roll of the heat-set film Surlyn, in the foreground, is positioned to mount the paper to the aluminum sheets. The custom-built 8 × 10 inch enlarger used to make enlarged interpositives is at left. A simple point-light source, which hangs from the ceiling just behind the enlarger, was used for exposing full-scale negatives and masks by contact. © The Irving Penn Foundation.

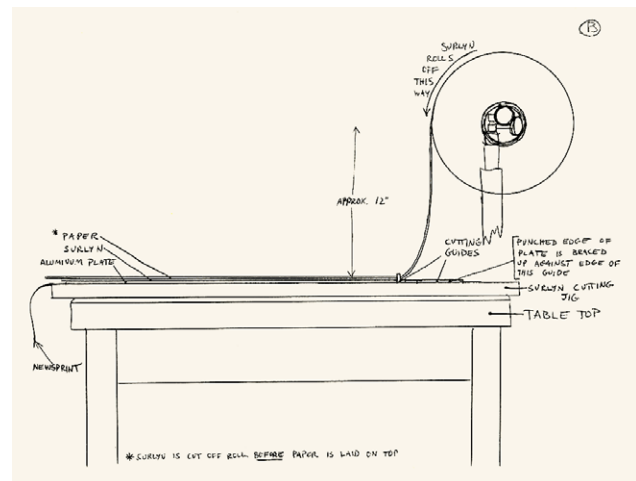


Figure 11. Unnamed assistant's diagram, c. 1973, illustrating Penn's system for platemaking and showing the assembly used to laminate the paper to the plate using a DuPont heat-set product called Surlyn. Lamination was achieved by using a dry mount press to apply even heat and pressure to the surface, which fused together the printing paper and Surlyn to the aluminum. The Art Institute of Chicago, Ryerson and Burnham Libraries, Irving Penn Archives. © The Irving Penn Foundation.

thoroughly rinsed them with filtered water to provide a clean and slightly roughened surface.²²

The choice of paper was critical, so Penn tested numerous high-quality, all-rag stocks for his prints, most often using the following papers: Arches Aquarelle Grain Satiné, Bienfang Admaster 406, Bienfang Graphics 360, Crane and Company's Platinotype, Rives BFK, Rives Bristol 100, Strathmore Carillon, and Wiggins-Teape.²³

Penn prepared his plates by first adhering a high-quality paper to the reverse side of the aluminum support sheet,²⁴ and then adhering the "printing" paper to the face, using a heat-set product that he discovered in 1965: Surlyn A 1650, a DuPont polymer routinely used in food and cosmetics packaging.²⁵ Working with third-party plastics manufacturers, Penn had the Surlyn, supplied as granules, converted to film and pigmented with opaque titanium white as specified by DuPont.²⁶ He then applied this custom-made film to both sides of the aluminum to provide a waterproof barrier between it and the paper while at the same time reinforcing the opacity and brightness of the paper (figs. 10, 11).²⁷

Using Pin Registration to Make Multiple Negatives

Penn's approach to making negatives for the platinum-palladium process drew extensively from his experience with photomechanical reproduction and the dye transfer process. Both require the image to be dismantled and reconstructed according to the spectral requirements of the imaging system to accurately reproduce all the tonal information in the original artwork, and both depend on pin registration for precise alignment of the components.²⁸

Stimulated by the possibilities that photographically dissecting, then reassembling, an image might offer for his platinum-palladium prints, the technically predisposed Penn declared in late 1964, "It opens a whole area of work that fascinates me. It requires a frightening amount of equipment, laboratorial help, and simple knowledge. It becomes a very complex medium, but I don't know any way out of it. I wish it could be simpler."²⁹ Separating an image into multiple negatives, preparing them to be printed, and fabricating the supports for the prints greatly complicated the process, but Penn felt the system gave "enormous scope to the printing possibilities."³⁰

Making the enlarged negatives for the platinum-palladium process was a technically elaborate, multistep production (see appendix A). It began with a camera original, the majority of which were film negatives, made in either the



Figure 12. Irving Penn, *Sitting Man with Pink Face*, New Guinea, 1970. Ektachrome transparency, 6 × 6 cm. Courtesy and © The Irving Penn Foundation.

6 × 6 cm or the 8 × 10 inch format. Penn used 4 × 5 and 8 × 10 inch enlargers to project his original camera negatives onto approximately 20 × 24 inch continuous tone film to produce his enlarged interpositives (or "diapositives," as Penn called them).³¹ The enlarged interpositives were then contact-printed onto sheets of film of equal size to produce duplicate negatives that included the full range of tonal information, from highlight to shadow, which he called "full-scale" negatives.

When Penn was working from an original color transparency, as was the case in *Sitting Man with Pink Face* (fig. 12), the interpositive step was unnecessary. The original 6 × 6 cm color positive of this image was projected onto 20 × 24 inch continuous-tone film to produce the full-scale enlarged negative.

To reinforce particular tonal information in his large-scale contact prints, such as to restrain or extend the highlights and shadows, Penn created negative sets by contact-printing the full-scale negatives onto film to produce multiple enlarged negative masks. These negatives, used individually and in pairs, were exposed to the sensitized plates in various combinations at different points in his printing process using a registration system that allowed perfect alignment of the image from exposure to exposure.

Pin Registration

To achieve absolute alignment of the enlarged negatives on the plate at every step of his printing process, Penn employed pin registration equipment consisting of precision punches, vacuum easels, stainless steel register strips manufactured by the Condit Manufacturing Company, and vacuum frames from the Harold M. Pitman Company (fig. 13).³²

The enlarged negatives were aligned using the Condit Matrix Film Punch (fig. 13a), a device that produced four 5 millimeter elongated holes that exactly matched both the pins on a vacuum easel (13b) and the register strips (fig. 13c).³³ The register strips were used in conjunction with both the negative sets and the plates. The plates were perforated with a series of holes that corresponded to those in the register strips and film, all of which were then bolted in place (fig. 13c–f).

This pin registration system allowed the negative or negatives to be precisely positioned in contact with the sensitized plate and exposed, alone or in combination, multiple times.

Making the Enlarged Interpositives and Duplicate Negatives

Penn's first step in making an enlarged negative from a smaller camera original was to project the image to the desired size onto large-format film.³⁴ The unexposed film was positioned on a vacuum easel, a device that consists of a smooth planar surface with recessed channels from which air is evacuated to hold the film stock perfectly flat (see fig. 13b). If the camera original was a positive color transparency, it was projected to create an enlarged full-scale negative directly. If the camera original was a negative, it was projected onto the unexposed film to produce an enlarged interpositive, which was then contact-printed onto a similar-size film to produce a full-scale negative.

After processing the full-scale negative, Penn made sets of negative film masks to fine-tune and maximize the tonal range of each print. The selection of film, its exposure, and its development could each be adjusted to produce negative masks in a wide range of densities and contrasts to meet his needs. Masks that Penn referred to as "specular masks" were used to modify subtle detail in the highlights, and "overprinters" ensured rich, inky blacks in the shadows.

To make his negative overprinters, Penn used direct-duplicating films. Unlike conventional films, which produce a negative image from a positive source (or vice versa), direct-duplicating (or autopositive) film produces negatives directly from negatives, eliminating the need to produce an intermediate interpositive.³⁵ Direct-duplicate films require more exposure than conventional films to produce less density but are processed with conventional negative developers.³⁶ As a result, making "specular masks" required longer exposure times than "overprinters" but had considerably less image information.

Penn used a vacuum frame to expose his masking films by contact. Unlike the relatively simple vacuum easel, which was used to expose one sheet of film at a time by projection, a vacuum frame is an assembly in which the negative and unexposed film are placed in firm contact by sandwiching them between a metal-framed sheet of plate glass and a rubber platen. A vacuum draws the air from the frame to pull the rubber platen and pair of films against the glass, through which the film is exposed (fig. 13g).

With the enlarged printing negative sets in hand, Penn aligned all the films on a light box and verified them by visual inspection using an engraver's loupe. Each film was then secured with tape to a narrow band of excess film that was punched for registration. The punched band of film, which corresponded to pins on the register strip bolted at the top of each plate, secured the films together in precise alignment while in contact with the sensitized paper during exposure (see fig. 13c–f). The nonimage area of the negative around the picture's margins was concealed with rubylith³⁷ tape and sheets in preparation for exposure to sensitized plates. Once the negatives were positioned on the register strip's pins and secured to the sensitized plate, the plate was ready for exposure in the vacuum frame (see figs. 9, 13g).

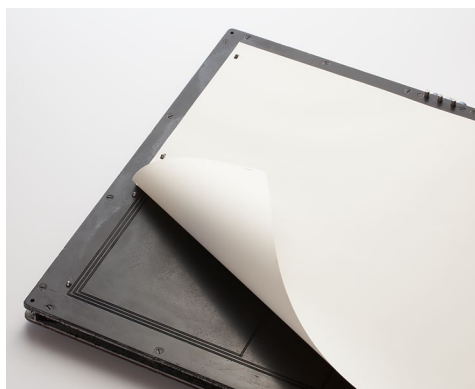
Negative Codes

Using an alphabetic code, Penn recorded which negatives he used at each step. For example, "FSc" stood for the "full-scale" enlarged negative that provided the complete tonal range. "Spec" denoted his "specular masks" (or "highlight masks"), which controlled fine highlight details. "Litho," "ov," or "opr" were used to indicate "overprinters," the high-contrast films that allowed shadows to be burned

Figure 13. Irving Penn's registration system, photographed in 2017. For clarity of illustration, paper is shown in lieu of film.



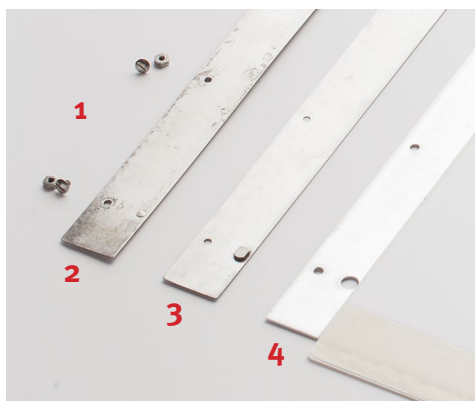
13a. Condit Matrix Film Punch that produced 5 millimeter elongated holes in the film corresponding to the elongated pins on both the vacuum easel and the register strips.



13b. Film positioned on vacuum easel, showing perforations in the film and corresponding registration pins. Note the recessed channels in the easel from which air is evacuated to hold the film stock flat.



13c. Stainless steel register strips and punched plate. The top edge of the plate shows the exposed aluminum with holes that correspond to the round pins on the back of the register strips (large holes) and bolts (small holes) that held the register strips to the plate.



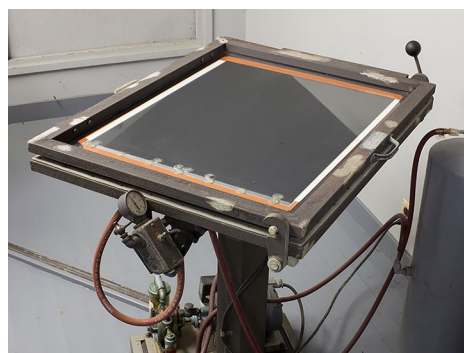
13d. Detail of the strips and punched plate shown above. 1. Bolts secure the register strips to the plate. 2. Register strip face down, showing round pins that correspond to large holes in plate used to bolt the register strip to the plate. 3. Register strip face up, with elongated registration pins. 4. Punched plate ready to receive register strip.



13e. Register strip bolted to the sensitized plate and the punched film placed on the registration pins.



13f. Detail of film in place on the sensitized plate, ready for exposure in vacuum frame.



13g. One of Penn's vacuum frames, of the type used to expose the masking films and sensitized plates by contact. The vacuum frame was rotated into a vertical position for exposure.

Table 1 | Irving Penn's Positive and Negative Films





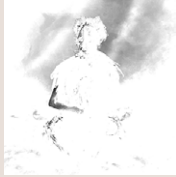


Film	Film Type	Purpose	Code	Method	Film Stock (Developers)	Example of Tonalities
Original camera positive (color) 6 × 6 cm or 8 × 10 in.	Conventional color reversal film (positive to positive)	Used to produce an enlarged negative	—	Exposed in camera; processed by commercial laboratory	Kodachrome (Processed by Kodak) Ektachrome (E-6)	
Original camera negative (black-and-white) 6 × 6 cm or 8 × 10 in.	Conventional panchromatic film (positive to negative, negative to positive)	Used to produce an enlarged interpositive	—	Exposed in camera; processed by commercial laboratory or Penn's studio assistant.	Kodak general purpose films including Tri-X Pan Professional, Plus-X Pan Professional, (various developers)	
Enlarged interpositive, 20 × 24 in.	Conventional orthochromatic and panchromatic film of moderate to high contrast (positive to negative, negative to positive)	Used to produce enlarged negatives with full tonal scale for contact printing	—	Original negative projected onto 20 × 24 in. conventional film (negative to positive); conventional developer type and dilutions varied according to desired tonal range	Kodak Commercial Film 4127 (Agfa Rodinal, Ethol UFG), Kodak Professional Copy Film 4125 (Agfa Rodinal, Kodak HC-110), Kodak Separation Negative Film, Type 2 (Agfa Rodinal)	
Enlarged full-scale negative, 20 × 24 in.	Conventional orthochromatic and panchromatic film of moderate to high contrast (positive to negative, negative to positive)	Used to print all information in original negative, including high-light details	Basic, FSC, F Sc, F Scale, Full scale	Original positive projected onto 20 × 24 in. conventional film (positive to negative), or enlarged interpositive is contact-printed onto conventional film (positive to negative) to produce full-scale enlarged negative; conventional developer type and dilutions varied according to desired tonal range	Kodak Commercial Film 4127 (Kodak D-11, Kodak DK-50), Kodak Professional Copy Film 4125 (Agfa Rodinal, Kodak HC-110), Kodak Separation Negative Film, Type 2 (Agfa Rodinal, Kodak D-11, Kodak DK-50)	
Specular mask, 20 × 24 in.	High-contrast direct-duplicating orthochromatic film (positive to positive, negative to negative)	Used to mask highlights in print to increase contrast, usually in combination with enlarged full-scale negative. Also called "high-light mask."	Spec, Specular	Enlarged full-scale negative contact-printed onto direct-duplicating film (negative to negative); processed with high-contrast developer or highly concentrated conventional developers	Kodalith Duplicating Film 2574 (Kodalith Liquid Developer), Kodak High Speed Duplicating Film 2575 (Kodalith Liquid Developer), Kodak Precision Line Duplicating Film LPD7 (Agfa Rodinal, Kodak D-11)	
Overprinter 1, 20 × 24 in.	High-contrast direct-duplicating orthochromatic film (positive to positive, negative to negative)	Used to burn in midtones through shadows in print for increased contrast and density	Opr 1, Ov 1, Overpr 1, Overprinter 1, Soft ov, Weaker overprinter	Enlarged full-scale negative contact-printed onto direct-duplicating films (negative to negative) using approximately 50% less exposure than Specular mask to achieve greater density (counterintuitive); processed with high-contrast developer or highly concentrated conventional developers	Kodalith Duplicating Film 2574 (Kodalith Liquid Developer), Kodak High Speed Duplicating Film 2575 (Kodalith Liquid Developer), Kodak Precision Line Duplicating Film LPD7 (Agfa Rodinal, Kodak D-11)	
Overprinter 2, 20 × 24 in.	High-contrast direct-duplicating orthochromatic film (positive to positive, negative to negative)	Used to burn in darkest tones in print for greater shadow density	Litho, Opr 2, Ov 2, Overpr 2, Overprinter, Overprinter 2, Hard ov, Stronger overprinter	Enlarged full-scale negative contact-printed onto direct-duplicating films (negative to negative) using approximately 50% less exposure than Overprinter 1 to achieve even greater density (counterintuitive); processed with high-contrast developer or highly concentrated conventional developers	Kodalith Duplicating Film 2574 (Kodalith Liquid Developer), Kodak High Speed Duplicating Film 2575 (Kodalith Liquid Developer), Kodak Precision Line Duplicating Film LPD7 (Agfa Rodinal, Kodak D-11)	

Figure 14. Lab B processing room, c. 1986. The stainless steel vertical tank used for sizing, washing, and deacidification is at lower left. The tank, the external dimension of which measured 30 × 23 × 5½ inches, was equipped with an enclosed “water jacket” along each side and at the bottom of the tank to recirculate heated water to keep the gelatin size warm and prevent gelling. The 30 gallon polyethylene tank above held the deacidification solution. At right is the cylinder holding the compressed carbon dioxide. © The Irving Penn Foundation.



in to give dense blacks. Table 1 lists the positive and negative films Penn used, and the corresponding codes he assigned to them in his worksheets.

Sizing

The papers Penn used for his platinum-palladium prints, listed above, were sized as part of the paper manufacturing process.³⁸ Sizing is an important component of these papers because without it the paper would act like a blotting paper, soaking up vast amounts of costly sensitizer. In addition to maximizing the amount of sensitizer that remained on the uppermost surface of the paper, sizing also provides essential wet strength and improves the paper’s dimensional stability.

Early twentieth-century handbooks routinely discuss the use of sized papers for platinum printing, and occasional mentions of superficial sizing of commercial papers for platinum printing are found in the photographic literature.³⁹ The texts consulted by Penn include recipes for sizing papers, such as Rives, with gelatin⁴⁰ and recommendations for using ready-sized paper or superficially coating paper with gelatin.⁴¹

Penn’s records indicate that he tested other sizing recipes, including arrowroot starch, which he never used to make finished prints because he found it “unpleasant to handle and results mottled.”⁴² Instead, Penn preferred to size his paper with a gelatin-alum solution, a practice he adopted as early as 1965,⁴³ as it produced “a harder result in the quality of the print” with “no slickness apparent, or any other detrimental visual effects.”⁴⁴ His standard recipe for size was composed of a purified grade of gelatin and alum (potassium aluminum sulfate) in water. He sized unmounted sheets of paper in trays and plates in a vertical stainless steel tank (fig. 14).⁴⁵ The gelatin solution had to be kept warm to maintain low viscosity and prevent gelling, so both the tray and tank methods employed a surrounding warm-water jacket outside the sizing vessel to keep the gelatin from cooling during the application process.

The gelatin size recipes that Penn noted in his records changed slightly over the years, with the primary differ-

ence being their dilution in water. Penn’s directions, from about 1968, for preparing his gelatin size for Arches and Wiggins-Teape papers follows:

USE FILTERED WATER ONLY

- Soak 100 grams of gelatin in 1500 cc of cold water for 3–5 minutes.
- Place over heat (double boiler) and melt (temp will rise to 120–135°F).
- Dissolve 20 grams of potassium alum in 500 cc of hot water. Place on direct heat for quick results.
- Fill mixing bucket with 6000 cc of hot filtered water (120–130°F) and add both melted gelatin and dissolved potassium alum and stir together to make 8000 cc working solution.

Note: Be sure to clean all utensils and materials and your hands with filtered water!

CONTAMINATION IS PRESENT EVERYWHERE⁴⁶

Penn sized his plates before the initial sensitizing step, sometimes resizing the plates between the first print and second printings. After the processing of the first printing was complete, the plate was resized, sponged to remove any bubbles or streaks in the gelatin, dried, and sensitized again for the second printing.⁴⁷ Some prints received a finishing coat of gelatin to “enrich the blacks with the hope of arriving at velvety rich blacks without affecting the highlights.”⁴⁸

Sensitizing

Penn consistently used a combination of standard stock solutions to prepare his platinum and palladium sensitizers, which were based primarily on those published by Carroll Bernard Neblette in the 4th edition of his compendium, *Photography: Its Principles and Practice*.⁴⁹ This

Table 2 | Irving Penn's Sensitizer Formulations and Codes

	Solution	Sensitizer Code	Composition	Notes
Palladium salt	Palladium, normal strength	3	Sodium tetrachloropalladate(II) 50 g Water (distilled) 333 cc	In select cases, iridium and/or hydrochloric acid added
	Palladium, concentrated	3-2x	Sodium tetrachloropalladate(II) 100 g Water (distilled) to make 333 cc	
Light-sensitive iron salt for palladium	Ferric oxalate for basic contrast	1	Ferric oxalate 261 g Oxalic acid 18 g Water (distilled) 1000 cc	In early worksheets (after 1978) the numeral "2" used to denote the basic contrast solution Penn experimented with adding greater concentrations of potassium chlorate to the sensitizer, using multiple "H"s in his codes, but these solutions were not generally employed The alphabetic code "2H+" dates to about 1967; "2HH" was used 1996-99
	Ferric oxalate for medium contrast	2	Ferric oxalate 261 g Oxalic acid 18 g Potassium chlorate 5 g Water (distilled) 1000 cc	
	Ferric oxalate for high contrast	2H	Ferric oxalate 261 g Oxalic acid 18 g Potassium chlorate 10 g Water (distilled) 1000 cc	
	Ferric oxalate for extreme contrast	2(H+), 2(HH)	Ferric oxalate 261 g Oxalic acid 18 g Potassium chlorate 20 g Water (distilled) 1000 cc	
Platinum salt	Platinum	A	Potassium tetrachloroplatinate(II) 100 g Water (distilled) 600 cc	
Light-sensitive iron salt for platinum	Ferric oxalate for basic contrast	B	Ferric oxalate 218 g Water (distilled) 1000 c	Beginning in 1974, Penn simplified his coatings by reducing the number of solutions and no longer used the alphabetic codes "B," "C," "C(H)," and "C(H+)"; instead, he used the numeric codes shown above for light-sensitive iron salt used for the palladium sensitizer because they were essentially interchangeable with those used for platinum; "A," however, was consistently used to denote the use of the platinum component
	Ferric oxalate for medium contrast	C	Ferric oxalate 218 g Potassium chlorate 4.5 g Water (distilled) 1000 c	
	Ferric oxalate for high contrast	C(H)	Ferric oxalate 218 g Potassium chlorate 9 g Water (distilled) 1000 c	
	Ferric oxalate for extreme contrast	C(H+)	Ferric oxalate 218 g Potassium chlorate 18 g Water (distilled) 1000 c	
Other components	Water	W	Water	Winsor & Newton, a brand Penn used, suggested 3-4 drops per cup of water as a wetting agent; whether he used the solution directly as supplied or diluted it is unclear Added only to palladium when used; ratio of palladium solution to iridium solution varied from 3:1 to 1:1
	Ox gall	OG	When used, ranged from 1 part ox gall solution to 10 parts metal salt solution - to - 1 part ox gall solution to 4 parts metal salt solution	
	Iridium	IR, IRID	Iridium salt 2.6 g Water (distilled) 15.6 cc	

Sources: The quantities shown in this table under "Composition" are extrapolated from Penn's calculations in notebook B4, typewritten notes, 1965, series XVI, box 182, folder 5, and notebook C5, handwritten notes, 1967, series XVI, box 184, folder 5, Irving Penn Archives, Ryerson and Burnham Libraries, The Art Institute of Chicago, as well as from his handwritten notes, n.d., adhered to coating table in Lab A.

volume, which includes references to the platinum formulas of Anderson and Clerc, is frequently cited in Penn's notebooks, and it provides the detailed formulas that Penn used for most of his platinum-palladium prints. His library included texts that provide insights regarding how basic sensitizer formulations might be modified for special purposes, such as to adjust image tone or contrast.⁵⁰

The individual stock sensitizer solutions, which included light-sensitive ferric oxalate, platinum and palladium salt solutions, and often a contrast enhancer, were mixed in various proportions as needed for each printing session. The solutions kept well in the dark but had to be used soon after the components were mixed. Penn observed, variously:

I have found that palladium produces a much smoother and more detailed result than platinum, but somewhat too soft and lacking in darks. The image is also too warm for my taste.⁵¹

There is a serious difference in the behavior of platinum and palladium as a coating medium. Literature to the contrary is nonsense.

Palladium is softer and tends to have softer edges to the grain. It continues to bleach for hours in HCl. . . . It is difficult to decide on an exposure since one must attempt to prevision the final result of hours later.

Platinum is harsher and cleaner than palladium. The grain is more apparent than even in the negative from which the print is made (there is a limit apparently to the softness one can get on platinum.) However—the image as it appears in the developer is exactly what will be there even hours of HCl later! This is a joy.⁵²

Sensitizer Codes

Penn used codes as a shorthand method to record the components and quantities of the sensitizers he used for his prints. While he did experiment with variants of these formulas, most of his sensitizer components remained consistent over the years, as did the codes he used for abbreviation. The basic components of Penn's standard sensitizers and the corresponding codes he used to record them on his worksheets are shown in table 2.

Penn's alphanumeric codes are loosely based on those of Anderson, who popularized the often-republished drop method of mixing the components of the sensitizer that

Penn employed in his early trials.⁵³ Penn used "A," "B," and "C" to refer to the components of his platinum sensitizer, and "1," "2," and "3" refer to the components of his palladium sensitizer. The letter "H" was used to denote the incorporation of the contrast-enhancing agent, potassium chlorate, to produce a "harder" print. "H+" and "HH" indicate an increase in the concentration of potassium chlorate to produce prints with even greater contrast. The letter "W" stood for water. For brief periods Penn also incorporated ox gall ("OG"), a wetting agent derived from purified bovine bile,⁵⁴ and an iridium salt ("IR" or "IRID") in the palladium sensitizer to increase the warm tones in the metallic image. Penn noted that iridium's "great cost is a discouraging factor in its use."⁵⁵

Numerals, which Penn listed on his worksheets to the right of his alphanumeric sensitizer codes (circled on his worksheets), indicated the volume of each solution. Using the drop method described by Anderson,⁵⁶ Penn experimented with drops of each solution in his early trials. When combined, these drops would equal enough total sensitizer to coat his test prints. Once satisfied with the combination, he then multiplied the drops to calculate the volume needed to coat multiple large sheets of paper or plates. He noted on a circa 1967 worksheet for printing images from his *Small Trades* series, most of which were made on Arches paper, "4 times the drop quantity in CCs [mls] gave us 6 sheets and a test strip."⁵⁷ From this time on, Penn recorded his sensitizer volumes in milliliters.

Penn used the platinum or palladium sensitizer individually, or he combined them into one solution for use in one or more printings. He found advantages in combining the sensitizers:

There is the depth and harshness of the platinum in the shadows, and the sweetness and delicacy of the palladium, especially in the highlights. The Platinum-Palladium combination seems to be at least 1½ times faster than platinum alone.⁵⁸

A combination of platinum and palladium seems to give a finer and sweeter result than platinum alone. It is also less expensive. The slight warmth given by the palladium is less appealing, but the fineness of the palladium part of the image seems worth the shortcomings of color.⁵⁹

Combining both the platinum and palladium solutions was an option suggested by E. J. Wall as early as 1923⁶⁰ but was not a common practice until Penn's successful use of the

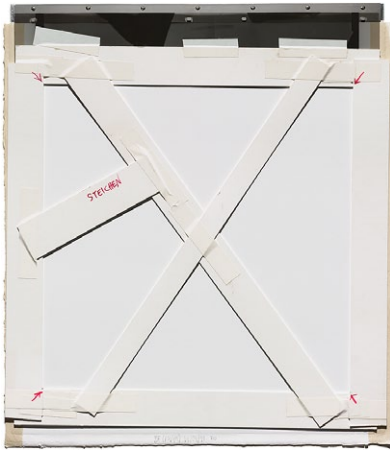


Figure 15. The stencil placed on a prepared plate. Penn used this type of stencil to mark the corners of his image in preparation for sensitizing.



15a. Detail showing the pencil dots just beyond the corner of the image.

combination helped to initiate the platinum and palladium processes' revival in the 1970s. It has since been regularly employed by platinum-palladium printers to this day.⁶¹

Sensitizing the Test Strips and Plates

With the negatives, plates, and stock solutions for the sensitizers ready for printing, Penn could begin the coating process. "Over the years," he wrote, "I must have spent thousands of hours silently brushing on the liquid coating, preparing each sheet in anticipation of reaching the perfect print."⁶²

Penn determined the area of paper to be coated by assembling a simple cardboard stencil using the enlarged full-scale negative in the set as a guide (fig. 15). To guarantee accurate placement on the plate, the stencil was pin-registered to align perfectly with the negative set. Penn placed the stencil on the plate and made pencil dots at each of the stencil's four corners to indicate the area to be sensitized (fig. 15a). He delineated the perimeter with tape to help confine the sensitizer during application and provide a well-defined edge for the image.⁶³ The plate was then ready for coating by brush (fig. 16).

Penn then performed a series of tests to determine the ideal starting points for the sensitizer formula, negative combination, and exposure. He sensitized one full-size prepared plate and a test strip, allowed them to dry, then exposed and processed them. He continued to fine-tune the sensitizer components and their proportions, and to adjust the exposure times, until he achieved the results he desired in his final prints.

The amount of sensitizer Penn used varied depending on the paper he selected. According to Penn, "In general

Arches paper requires 50 to 100% more platinum solution than Wiggins Teape."⁶⁴ He also found that, "For a rich velvety black it is necessary to coat the paper quite heavily, brushing out the coating mixture for a long period of time."⁶⁵

Exposing

When Penn purchased the first of his two Ascorlux printing lights, the Pulsed Xenon Arc (PXA) lamp was a fairly new technology. Introduced by the General Electric Company in May 1958 as a quartz lamp "designed primarily to expose slow-speed photo-sensitive materi-

als," the new light source promised "substantial savings in maintenance costs, power and air-conditioning for the printing and publishing industry."⁶⁶ At the same time, the American Speedlight Corporation, a Middle Village, New York, firm that specialized in electronic flash apparatus, introduced its Ascorlux equipment line as the first to incorporate the new PXA lamp, thus "opening a new area in controlled lighting for the Graphic Arts Operations."⁶⁷ Similar to other graphic arts printing lamps used to expose photosensitive materials, the Ascorlux lamp emitted the high-intensity ultraviolet radiation necessary to expose Penn's sensitized platinum and palladium plates.

With his 4000 watt and 8000 watt pulsed xenon arc lamps at his disposal, it was efficient for Penn to print negative sets for two different images at the same time. Having established the parameters for his exposure sequences by inspecting his processed test prints, Penn proceeded to expose the sensitized plates. Once the surfaces of the glass of the vacuum frame, negative, and plate were carefully



Figure 16. Sensitizing brushes hanging from pegboard above the coating table in Lab A, c. 1986. © The Irving Penn Foundation.

cleaned of any dust, the plate and pin-registered negative or negatives were placed in the vacuum frame while in the horizontal position (see fig. 9). The frame was then closed, and the vacuum pump was activated to create perfect contact of negative and plate. The frame's rubber platen provided the cushion required to accept the thickness of the register strip that was used to align the two punched films as they were brought into contact. Penn went so far as to modify the glass of the vacuum frame: "Indentations were ground into the printing frame glass to accommodate the raised studs of the register strip and insure absolute flat contact of the elements enclosed in the frame during exposure."⁶⁸ Once under vacuum, the frame was rotated into the vertical position to face the printing lamp and begin the exposure. Operating the light source was rudimentary as it was turned on and off using the basic but indispensable Gralab 300 timer.

The distance of the lamp to the vacuum frame was adjustable, as each light source traveled on a track fixed to the floor.⁶⁹ Penn was aware that the "further the light source is from the printing frame, the nearer it approaches a point source,"⁷⁰ thereby increasing the sharpness of the print. Penn's worksheets indicate that he generally set the 4000 watt lamp at a distance of 2½ feet and the 8000 watt lamp at 3½ feet to maximize sharpness and minimize exposure times.

It was not uncommon for Penn to interrupt an exposure to change, add, or remove negatives. This pause was possible because of the pin-registered negative sets and plates. To switch negatives, he simply stopped the timer, rotated the vacuum frame to its horizontal position, disengaged the pump, opened the frame, and exchanged the negative or negatives. To continue exposing, the frame was again closed, the vacuum activated, the frame rotated to vertical, and the lamp's timer restarted.

In addition to the amount of ultraviolet radiation discharged by the Ascorlux lamps, exposure times were influenced to a large degree by the formula of the iron solution or solutions Penn used in his sensitizer, as these controlled the contrast of the print's image. Furthermore, the density and contrast levels of the negatives used for printing also influenced exposure times. Depending on these variables, the length of exposure varied greatly, "from several minutes to two hours or more."⁷¹

Underprinting and Overprinting

Penn varied his combinations of sensitizers, negatives, and exposures in myriad ways. He commonly applied the plati-

num sensitizer alone for the first exposure, or "underprinting," using the full-scale negative (sometimes combined with a mask) to produce a fully rendered "underprint." He wrote, "Using platinum as the underprinting gives one the chance to abandon the plate early in the game if it seems that the highlights are too dark or too light, since the image is unalterable by further time or manipulation."⁷² To achieve lower densities in the print, Penn diluted the sensitizer with water ("W"). After the first printing was thoroughly processed and dry, he might then coat a high-contrast platinum-palladium sensitizer (palladium was rarely used alone) or diluted sensitizer over the platinum underprint for the "overprintings." He then exposed the sensitized plate with the full-scale negative, specular mask, and/or high-contrast mask, and processed the plate.

After he arrived at a successful sensitizing and exposure combination, Penn usually sensitized two or three plates at a time, starting with the underprintings, exposing them in sequence while continuing to make adjustments to negative combinations and exposure times. After the plates had been processed and dried, Penn studied them to determine how to sensitize them and what negatives to use for the overprinting in the next session.

Recording the Process on Worksheets

In his quest to produce the perfect platinum print, Penn meticulously recorded the key information relating to the formulation of his sensitizers, the exact negatives, the duration of exposure, and the distance of the xenon lamp to his printing frame. More than 1,500 worksheets that record the production of his prints are preserved in Ryerson and Burnham Libraries of the Art Institute of Chicago. His early prints were relatively simple: each sheet of unmounted paper was sensitized and exposed once. As his printing method evolved into the complex series of multiple sensitizations and exposures of his pin-registered plates, Penn's documentation system also evolved and became very elaborate and challenging to decipher today.

Each worksheet must be interpreted within the context of its date of production, requiring careful examination of his notebooks and the associated chronology of his process's evolution. To decode the notations in Penn's worksheets, one must be familiar with the materials and equipment used, the steps that took place during each work session (which generally consisted of one day's work), and the corresponding coding system. It should be emphasized that while many of Penn's codes and recipes remained constant over time, some did change as he adjusted his

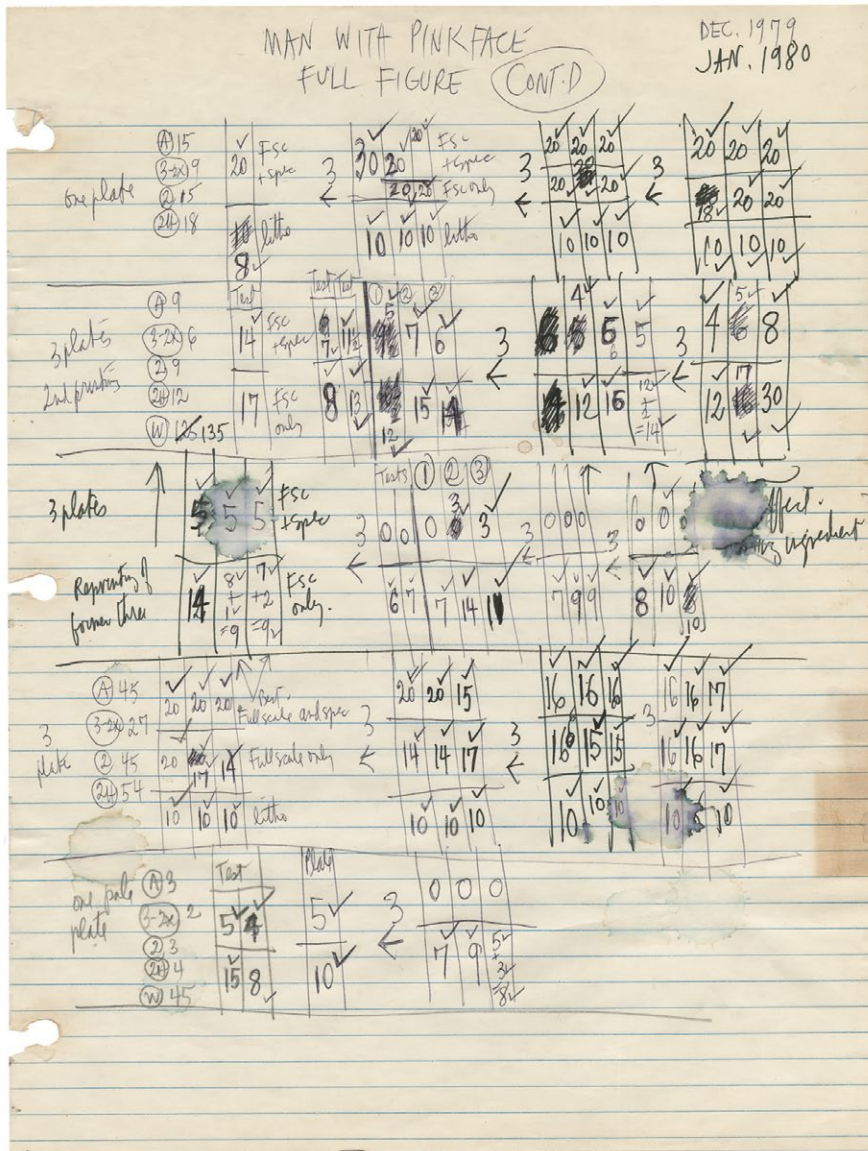


Figure 17. Worksheet for *Sitting Man with Pink Face*, 1979–80. Ink on paper, 28 × 21.5 cm. The Art Institute of Chicago, Ryerson and Burnham Libraries, Irving Penn Archives. © The Irving Penn Foundation. See appendix B for diagram and detailed caption.

Penn recorded essential information regarding his complex and labor-intensive steps in producing his prints (fig. 17; appendix B). The test prints and plates detailed on this worksheet were subjected to multiple sensitizations with different formulas and multiple exposures with a sequence of different negatives, which he combined to craft the nuanced tones of his prints. While this single worksheet cannot be considered comprehensive within the larger scope of Penn's printing evolution, it does include representative examples of his alphanumeric codes that are defined and illustrated in its accompanying captions.

This worksheet records several printing sessions for the platinum-palladium print of *Sitting Man with Pink Face* that took place in December 1979 and January 1980,

formulas or fine-tuned his unique descriptive shorthand.

Penn referred back to the notes on his worksheets weeks and years later when he returned to his negatives to reprint them, often reinterpreting them on different papers, in a variety of tones and levels of contrast, and occasionally in different sizes. His formulas and practices changed as he explored a wide variety of papers and chemical modifications to suit his very exacting aesthetic requirements. In 1977 Penn explained, "A series of prints from one negative is a continuous evolution of experimentation and research. In these platinum prints the sensitizer formulas, exposure times, and the kind of paper used is constantly changing. I often return to the same negative years later to continue printing in further experimentation."⁷³

Careful scrutiny of one worksheet may help devotees of analog photographic systems understand how

and it typifies Penn's method of recording multiple printings, including several tests and, in this case, twenty-one prepared plates. The worksheet, which is the second of two pages, illustrates many of the alphanumeric codes and abbreviations Penn used, his shorthand for sensitizer formulas and chemical volumes, the negatives used for each exposure, and the length of exposure. The first page of the worksheet (not shown), which is dated February 1979, indicates that the image area is 406 square inches and that Penn exposed the associated prints using his 8000 watt xenon lamp at a distance of 3½ feet from the plate.

The descriptions that caption this worksheet (see appendix B), when studied in conjunction with the information provided in appendix A and tables 1 and 2, are meant to lead the reader through Penn's working process and record-keeping system, and they provide a starting point for those scholars who wish to interpret Penn's worksheets

in order to understand his platinum-palladium printing methods. Again, it must be emphasized that Penn's record-keeping method evolved and changed over the years, so when attempting to decipher Penn's worksheets it is essential to consider the date of the record and the record-keeping system he was using at that time. The worksheet in figure 17 represents his documentation system at a mature point in his platinum-printing oeuvre.

Processing

Immediately after each exposure sequence was complete, Penn readied his plate for processing by isolating the exposed aluminum and stainless steel surfaces from the acidic processing solutions with an acid-resistant pressure-sensitive vinyl tape manufactured by 3M Corporation.⁷⁴ The vinyl tape barrier protected the aluminum along the edge of the plate and the bare stainless steel register strip, which would not be removed until printing was complete. Both the aluminum-supported plates, with all exposed metal thoroughly sealed, and unmounted prints were then ready for processing in the following baths:

platinum and palladium developer

- potassium oxalate, 1135 grams
- oxalic acid, 19 grams
- water (distilled), 1 gallon (3.785 l)

clearing bath

- hydrochloric acid (37%),⁷⁵ 3 ounces (88.7 cc)
- water (filtered), 1.5 gallons (5.68 l)

bleaching bath (c. 1969)

- sodium bisulfite, 1 pound (453.6 g)
- water (filtered), 3 gallons (11.36 l)

bleaching bath (c. 1994)

- sodium sulfite, 3 pounds (11.36 l)
- water (filtered), 3 gallons (11.36 l).⁷⁶

The exposed print was immersed in a tray of room-temperature developer and gently rocked for approximately 5 minutes. Once fully developed, the print was cleared of unexposed sensitizer in three consecutive trays of dilute hydrochloric acid.

Both unmounted prints and plates remained in each clearing bath for at least 30 minutes, with frequent agitation by lifting and lowering the plates in the solution and rocking the trays. Penn noted that plates "require a greater time to clear the iron salts because one side of the paper is isolated."⁷⁷ If any evidence of yellow sensitizer remained visible in a print, longer clearing—up to 10 hours total—was sometimes required. Penn observed that some papers required longer clearing than others and that Arches Satiné, in particular, required a long time "to remove

the residual iron in the hydrochloric acid after platinum development."⁷⁸ In about 1975 Penn wrote, "In processing Arches, I have often left the paper overnight in a holding bath of 150-1 HCl after 5 or 6 previous hours in HCL. Even then, although there is usually by then no obvious signs of iron stain visible, the paper seems to whiten and generally clear in a bath of 5% Sodium Bisulphite."⁷⁹

After a day's processing, the exhausted first clearing bath was discarded and replaced with the second bath. The third clearing bath replaced the second, and fresh acid was used for the final bath. After a minimum of 90 total minutes total in the clearing baths, the plate received an initial wash of 30–60 minutes in a tray mounted with a Kodak Automatic Tray Siphon to provide a thorough exchange of water and agitation. The tray of water was emptied and refilled every 5–10 minutes to ensure an effective wash.

In an effort to thoroughly remove any remaining iron salt, Penn treated the prints in a bleaching bath. Around December 1965 he began to use sodium bisulfite as bleaching agent,⁸⁰ but in later years substituted the more alkaline sodium sulfite.⁸¹ After the clearing and initial washing steps were deemed acceptable, effort was made to diminish any remaining evidence of the yellow sensitizer by bleaching the prints for 10–30 minutes,⁸² followed by a final wash of 60 minutes in running water with periodic replenishment and agitation⁸³ or "6–8 full changes of wash water is a tray."⁸⁴

Deacidifying

Penn went to great lengths to ensure the long-term preservation of his prints by choosing high alpha-cellulose papers, preventing contamination from the aluminum supports by sealing them with impenetrable barriers, and using thorough procedures to chemically clear and wash his prints. He recognized, however, that acidity was a major cause of paper deterioration and that the acids used in his process could contribute to the impermanence of his prints. Penn's lingering doubts regarding the permanence of his prints' paper support led him to seek ways to maximize their long-term chemical stability.

Concerned with the possible negative effects on the permanence of his prints of "the alum used in the original sizing steps of the paper and our resizing steps of the process," as well as of "the hydrochloric baths we subject the plates to,"⁸⁵ Penn explored several methods for imparting a neutral-to-alkaline pH to their paper supports.⁸⁶ In September 1971 he began to examine a preventive measure known as "deacidification" that had been investigated by scientists in the library and archives communities

since the 1950s as a means to ensure the durability of his platinum-palladium prints.⁸⁷ Following a year of in-depth research, experiments, and analysis,⁸⁸ Penn tested William J. Barrow's method of imparting an alkaline reserve to his prints that was suggested to him by the noted book-binder and paper conservator Carolyn Price Horton.⁸⁹ This method involved preparing a solution of magnesium bicarbonate by bubbling carbon dioxide gas through an aqueous suspension of insoluble magnesium carbonate.⁹⁰ In September 1972 Penn began to deacidify all his prints (both unmounted prints and mounted plates) as a means

to ensure their long-term preservation. He continued to include this treatment as standard practice and the final wet step of the printing process for all his platinum-palladium prints.⁹¹

Following developing, clearing, bleaching, and extended washing, the plates were immersed in the alkaline deacidification solution. Unlike Barrow's recipe, which utilized magnesium carbonate alone in water, Penn also included calcium carbonate:

- magnesium carbonate, 420 grams
- calcium carbonate, 105 grams
- water (filtered), to make 28 gallons (106 L).⁹²

The magnesium carbonate and calcium carbonate were thoroughly mixed in water, and carbon dioxide gas was introduced into the solution through rubber tubing from a 50 pound cylinder controlled by a regulator set to 7 pounds per square inch and allowed to bubble for 1 hour. The resulting solution including magnesium and calcium bicarbonates dissolved in water. The solution was allowed to rest for at least 2 hours, but Penn preferred to let it settle overnight to avoid possible precipitation onto his prints of any undissolved magnesium and calcium carbonates in the bath. Prints were immersed in the solution for 30 minutes in the same vertical stainless steel tank used for sizing his plates, then set to dry.

Drying

Following the final washing and deacidification steps, Penn set the printed plates on a custom-made horizontal rack of simple construction that allowed a large quantity of plates to air-dry (fig. 18). The rack was constructed of narrow lengths of epoxy-coated plywood with a pattern of finish nails, which just protruded from the top surface of the plywood. Each nail was covered in pressure-sensitive tape to avoid any contact of the iron nails with the plate's paper or aluminum. Each plate was set in a vertical position on the rack between rows of finish nails, upside down on its bare aluminum edge, leaning at a slight angle to the rack with its bottom corner barely touching the adjacent wall. The plates could then stand with minimal surface contact as they dried. This system allowed approximately sixty plates at one time to dry for several days in an isolated room with a dehumidifier to ensure all moisture was removed. Once dry, the plates were trimmed slightly to remove the excess paper and Surlyn around the edges.⁹³

Unmounted prints (not adhered to aluminum) were dried in "blotter packs" that consisted of sandwiches of clean blotter in contact with both surfaces of the print, with archival corrugated board on either side of the blotters to allow air to move through the boards' flutes.⁹⁴

Figure 18. Print drying assembly.

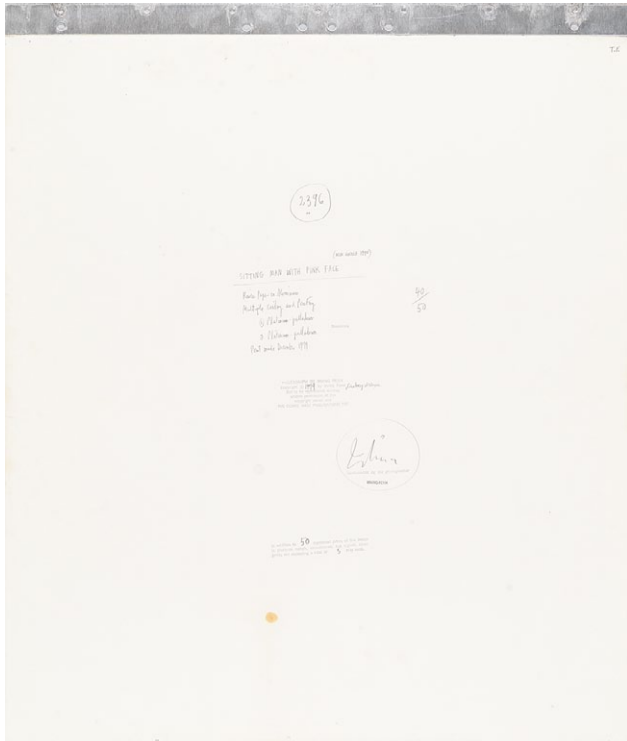


18a. Drying and storage room in Lab B, c. 1986. The plate drying rack runs along wall at left, illustrating the epoxy-coated plywood with a pattern of finish nails that held the plates while drying. © The Irving Penn Foundation.



18b. Plates of Penn's 1996 photograph, *Kate Moss, Hand on Thigh*, printed in platinum 1998, positioned in the drying rack with the exposed aluminum strip-side down.

Figure 19. Verso of the platinum-palladium print *Sitting Man with Pink Face* (fig. 4), with details showing annotations.



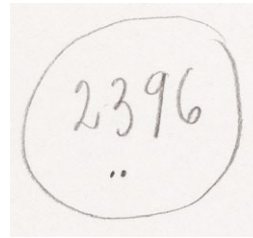
19

Dense paperboard sheets were then placed on both sides of the corrugated board, and the blotter packs were stacked in sets of three, weighted with 1/8 inch Masonite boards, and placed in a drying cabinet fitted with an exhaust fan to pull air through these carefully arranged stacks for approximately 3 days.

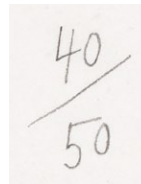
Documenting

Once Penn determined a print to be a finished work of fine art, he recorded critical information on the verso of the print (fig. 19). He wrote in 1977: “Because collectors are concerned with the number of examples that exist, I undertake not to exceed a maximum number of prints of any one picture in platinum metals. Each print is numbered. As a practical matter, since I coat each individual sheet myself, this maximum number may in some cases never be reached.”⁹⁵

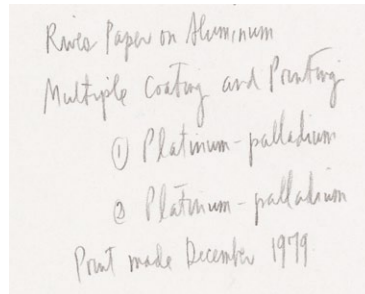
Penn inscribed the title of the photograph and related details, such as the location and date the image was taken. Inventory and edition numbers, along with copyright and edition stamps, provide important information about the print, and inscriptions describing the paper used,⁹⁶ type and number of sensitizations, date of the print, and a stamp indicating that it was deacidified provide valuable insights regarding how a print was made. Finally, the print was stamped “Hand-coated by the photographer” and signed, “Irving Penn.”



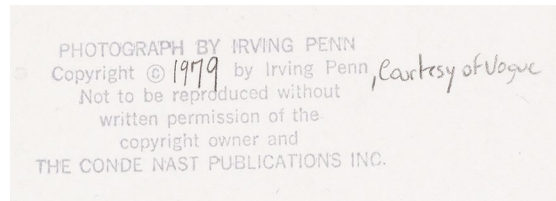
19a. The reference number, a unique number assigned to each print, is inscribed in graphite pencil in Penn’s hand.



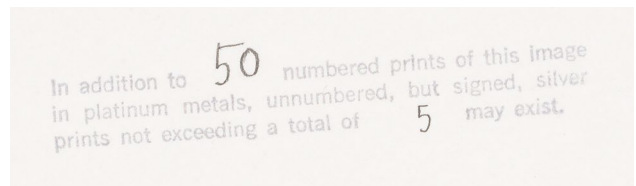
19b. The edition number, also inscribed in pencil by Penn, indicates this is print number 40 within an edition of 50.



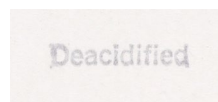
19c. Penn’s pencil inscription specifies that he used an unspecified Rives paper mounted on aluminum to make the print using two separate sensitizations and printings with platinum-palladium for both, and that it was printed in December 1979.



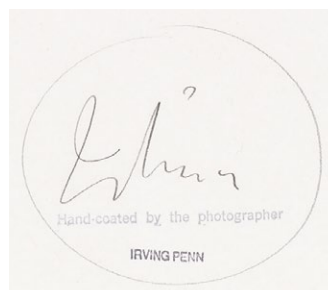
19d. The copyright notice is stamped in ink and the year annotated by Penn in pencil (“Courtesy of Vogue” was added by a studio assistant at a later date).



19e. Details regarding the platinum edition and other silver prints are stamped in ink and annotated by Penn in pencil.



19f. The plate was rubber-stamped in ink, indicating the deacidification process was complete.



19g. Penn’s signature in graphite pencil accompanied by “Hand-coated by the photographer” and “Irving Penn” rubber-stamped in ink.

421 Vasiliou Zatsis and Constance McCabe, “Irving Penn’s Platinum-Palladium Prints,” in *Platinum and Palladium Photographs: Technical History, Connoisseurship, and Preservation*, ed. Constance McCabe (Washington, D.C.: American Institute for Conservation of Historic and Artistic Works, 2017), 404–431.

Conclusions

Penn continued to print in these noble metals until the age of 83.⁹⁷ In his introspective book, *Passage: A Work Record*, a reflective 74-year-old Penn wrote modestly of his years as a practitioner, “Of course, I did not myself invent this technique. . . . I was simply relearning it and bringing to it both new ignorance and contemporary materials.”⁹⁸

While it is true that many of Penn’s recipes and working methods can be traced to an earlier generation of platinum-palladium photographers, the technically elaborate approach to creating his prints transformed the medium in a way incomparable to any other photographer. By the time his work as a platinum-palladium printmaker came to an end, his creative output in the medium numbered more than 9,600 prints made during a period that spanned nearly forty years.

Several factors contributed to Penn’s decision to cease platinum-palladium printing, including Kodak’s discontinuation of the analog materials upon which he relied for making his enlarged interpositives and negatives. The pulsed xenon lamps and converted Surlyn became difficult to procure. As his printmaking approach “was conditioned by the existence of modern materials” that “enrich the possibilities of hand-coated platinum,”⁹⁹ retreat from the process seemed inescapable. His interest in gelatin silver and color print processes grew, and he dedicated more time to painting, an artistic pursuit he abandoned as a young man but returned to in his late 60s.

A private man with impeccably high standards and a tireless work ethic, Penn spent countless hours studying the early literature and experimenting with his process. As his dedication to the process deepened, he consulted extensively with scholars, scientists, and conservators. While some perceived him as secretive, Penn did in fact share his knowledge with contemporaries. Although they may have found his highly engineered approach technically overwhelming, most regard Penn as the father of the platinum renaissance.

This essay’s authors, too, have been both daunted and inspired as they sought to negotiate the labyrinth that is Penn’s methodology. Many key aspects of his practices are presented here, but the reader must recognize that this essay is by no means comprehensive. The archival records held by Ryerson and Burnham Libraries of the Art Institute of Chicago hold the keys to a thorough understanding of Penn’s working methods and the knowledge required to preserve his masterworks in platinum and palladium.

Acknowledgments

We wish to thank National Gallery of Art senior conservation scientist Christopher A. Maines for working closely with us to reverse-engineer Penn’s process, traveling to study the Irving Penn Archives to help decipher Penn’s codes, and examining Penn’s platinum-palladium prints as we investigated his working methods. Colleagues Mike Ware, Matthew L. Clarke, and Joan M. Walker provided invaluable insights into the chemistry of Penn’s processes, and they carefully reviewed this essay in preparation for publication. National Gallery of Art photograph conservators Sarah S. Wagner and Ronel Namde studied several drafts of this essay and tables, helping to make complex content comprehensible. Senior paper conservator Marian Dirda shared her expert knowledge of the paper history and deacidification processes. Research assistant Caroline Minchew assisted in the preparation of the images for publication.

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Past studio assistants to Mr. Penn also provided invaluable insights into the evolution of his techniques: Robert Freson, Gordon Munro, Lennart Durehed, Olof Wahlund, Billy Jim, and in particular, Keith Trumbo. William Falkowski, caretaker of the Penn property on Long Island for sixty-five years, consistently assisted in any way he could.

The professional staff at The Art Institute of Chicago deserve special recognition for sharing their expertise and making the museum’s Irving Penn Archives available for study: Nathaniel Parks, Mary K. Woolever, and Joe Tallarico of the Ryerson and Burnham Libraries; Matt Witkovsky, Douglas Severson, Sylvie Pénichon, and Barbara Diener of the Department of Photographs; and Aimee L. Marshall for her support with image licensing.

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Notes

The epigraph is from Irving Penn, lecture at Wellesley College, Wellesley, Mass., April 23, 1975, edited transcript in Janis and MacNeil, 135.

1. Irving Penn, prepared remarks for the symposium, "What Is Modern Photography?" Museum of Modern Art, October 30, 1950, audio recording, online at WNYC News, www.wnyc.org.

2. Ibid.

3. Irving Penn, notebook C8, handwritten notes, n.d., Irving Penn Archives (hereafter IPA), series XVIII, box 185, folder 10, Ryerson and Burnham Libraries, Art Institute of Chicago.

4. In June 1964 the New York Public Library fulfilled Patricia McCabe's request for photocopies of the following texts on behalf of Penn: Anderson 1934, 133–280; Burbank 1887, 17–64, 96–104, 190–204, 210–216; Emery 190?, 1:9–92; Hinton 1899, 5–91; Wall 1940, 115–136, 210–230, 355–367; Pizzighelli and Hübl, 1:5–59. Call slips shown in microfilm, The Irving Penn Foundation, New York (hereafter TIPF). Other books referenced by Penn include Child Bayley 1906; Clerc 1954; Henney and Dudley 1939; Neblette 1942. Child Bayley, Clerc, and Neblette are cited in a summary prepared on a series of paper, sizing, and printing tests. Irving Penn, "Platinum Printing," notebook B4, c. 1965, series XVI, box 182, series 5, IPA.

5. See Jennifer Janauskas, "Overview: The Irving Penn Archives at the Art Institute of Chicago," online at www.artic.edu.

6. Technical notes reveal that Penn was equally interested in the gum bichromate process for making self-coated photographic prints. See Roland Pleterski, "Gum printing data," notebook A4, c. 1964, series XVI, box 180, folder 1, IPA.

7. Although the exact date of Penn's visit is not known, his desk calendar for 1963 is marked, "Penn to Rochester" on May 22. Studio Calendar, handwritten notes, 1963, series III, box 10, folder 9, IPA.

8. Irving Penn, recalling his visit to the George Eastman House with members of Alexey Brodovitch's "Design Laboratory," an interdisciplinary workshop for the graphic arts, in Alexey Brodovitch, Richard Avedon, and Irving Penn, "Alexey Brodovitch Workshop Session Notes: Design Laboratory, 1964, Including a Biography of Alexey Brodovitch; also, Richard Avedon/Irving Penn Session," typescript, n.d., 27, Ryerson and Burnham Libraries, Art Institute of Chicago, online at www.artic.edu.

9. These prints are tipped in to page titled "Platinum Printing" in Penn's "Album of experimental bits, exploring the printing of platinum, gum bichromate in black and in color, a variety of papers, sizings, and combinations," c. 1965, album (178 items within), 43.5 × 35.9 × 3.8 cm, The Art Institute of Chicago, 2004.448. The inscriptions on the prints refer to recipes in Neblette 1942, 692–96, including one by L. P. Clerc, in which the paper is sensitized with the iron compound and the platinum compound is in the developing bath; two examples made by Penn using this process are shown in figure 2 (labeled 1 and 2). Penn never again used Clerc's process, but pursued other recipes found in Neblette and elsewhere.

10. Penn 1991, 144.

11. Based on Penn's cataloging records for gelatin silver and platinum-palladium prints made 1937–99, TIPF. Penn's first exhibition-quality platinum-palladium prints were from his *Small Trades* series. For an in-depth examination of this work, see Heckert and Lacoste 2009.

12. Irving Penn, notebook A1, handwritten notes, n.d., series XVIII, box 185, folder 5, IPA.

13. The first exhibition, *I Platini di Irving Penn: 25 Anni di Fotografia*, opened at the Galleria Civica d'Arte Moderna in Turin, Italy (April 3–May 31, 1975), followed by *Irving Penn: Recent Works* at the Museum of Modern Art, New York (May 19–August 3, 1975).

14. Greenough 2005, 5. References in Penn's library include a volume by E. J. Wall that includes a suggestion for adding depth to the shadows of platinum prints by sensitizing a print "as though it were plain paper. . . . Any number of additional printings may be given." Wall 1940, 212. Penn's library also includes two works by Paul L. Anderson that explain how multiple printing in platinum can be achieved with careful registration that allows improved rendition of shadows. Anderson 1923, 208–9; Anderson 1934, 139.

15. From 1966 to 1970, Penn also made a series of multicolor gum bichromate prints on vinyl and porcelain-coated steel from his 35 mm color negatives, a process that required skillful preparation of separation negatives. For Penn's notes and worksheets on the process, see notebook B3, c. 1965–70, series XVI, box 182, folder 4, IPA.

16. Irving Penn, conversations with Vasilios Zatsis, 1996, during Zatsis's first laboratory session assisting Penn.

17. Prior to completing Lab A, Penn's work in the platinum-palladium process was conducted in his 80 West 40th Street studio. Following a tour of Lab A, Patricia McCabe, Penn's trusted personal assistant, wrote to him while he was on assignment in Europe, "I enjoyed poking around at the farm . . . and the studio, it is outstanding, very exciting, a thrill to inspect every nook and cranny . . . don't you need someone to wash dishes!?" Patricia McCabe to Irving Penn, July 9, 1965, series II, box 6, folder 24, IPA.

18. According to Keith Trumbo, Penn's studio assistant from 1968 to 1973, the preparation of plates and paper sizing took place at the 80 West 40th Street studio prior to the construction of Lab B. Billy Jim, Penn's studio assistant from 1988 to 2001, stated that plate preparation moved from Lab B to the 89 Fifth Avenue studio in the early 1990s. We are grateful for the valuable insights on Penn's process that Trumbo and Jim generously provided in phone conversations and e-mail communications during 2016 and 2017.

19. Penn used the terms "emulsions" and "coatings" to describe the sensitizer.

20. Ascorlux printing lamp assembly models A1151A and A1152, respectively.

21. Penn, notebook A12, handwritten notes, n.d., series XVIII, box 185, folder 8, IPA.

22. Penn, "Preparation of metal plates," notebook A14, 3–4, c. 1971, series XVI, box 180, folder 7, IPA.

23. Additional printing papers Penn experimented with were Arches Platine, Caledonian Parchment, Chatham, Crown and Sceptre, Fabriano Book, Hayle, New Millbourn (Glazed and Medium), Gampi Torinoko, and Whatman.

24. Lancaster Bond, Mohawk Superfine, and Strathmore 500 were most often used for the reverse. Wiggins-Teape is the only "printing" paper that was also used on the reverse.

25. DuPont product literature, "Surlyn® A 1650: For Film Lamination, Shape Extrusion, and Wire Coating," c. 1965, TIFP, gives the following information: "Description SURLYN® A 1650 is a general purpose ionomer resin. The very high molecular weight of this resin provides outstanding resistance to stress cracking environments, excellent impact toughness, and high tear strength. Typical of the family of ionomer resins, this product exhibits a high tensile strength, flex resistance at sub-zero temperatures, and excellent melt draw qualities. In laminations, this product exhibits strong adhesion to cellulosic substrates like cotton, paper or wood, and to metal or ceramic surfaces. . . . Processing SURLYN A 1650 resin will process over a broad temperature range (350–600°F) in conventional thermoplastic equipment designed for film, shape extrusion, injection molding, and moderate speed extrusion coating. . . . Food and Drug Status This resin meets the Food and Drug Administration requirements for ionomers to be used in food packaging."
26. Penn contracted with Pierson Industries Inc. of Palmer, Mass., and Film-Tec Corporation of Stanley, Wisc., to convert Surlyn to sheet rolls, 24 in. wide × 5 mil thick, with minimum orders of 1000 lbs. Invoice records, 1969–98, TIFP.
27. The assistant's diagram shown in figure 11 is part of instructional notes for mounting plates. To improve opacity, Penn adhered two layers of Surlyn to the surface of the plate during the mounting of the "printing" paper to the aluminum sheet. Notebook A25, c. 1973, series XVI, box 181, folder 10, IPA. Platemaking instructions from 1986 show the continuation of this two-step mounting process. JoAnn Baker, "Plate-Making Process for Irving Penn," handwritten notes, 1986, series XVI, box 184, folder 10, IPA. During author Zatse's years as a laboratory assistant, 1996–99, both the face and reverse papers were mounted to both sides of the aluminum sheet simultaneously.
28. In the late 1950s, Penn and assistant Robert Freson learned the dye transfer process to make precision prints for editorial and commercial assignments. Working from camera originals made with 35 mm high-speed color negative film, Penn and Freson made separation negatives using a custom-made point-light source enlarger in order to achieve the best quality possible. Robert Freson, conversation with author Zatse, July 6, 2016.
29. Penn, in Brodovitch, Avedon, and Penn, "Alexey Brodovitch Workshop Session Notes," 1964, 29.
30. Penn, "Platinum Notes I.P.," 2, handwritten notes, c. 1971, series XVIII, box 185, folder 5, IPA.
31. Unnamed assistant's notes indicate Penn ordered large format films in both 20 × 24 and 22 × 28 in. sizes. Penn cut the 22 × 28 in. film stocks down to 20 × 25 in. and used the remaining strips for tests. Notebook A17, c. 1974, series XVI, box 181, folder 1, IPA.
32. Pages from Condit Manufacturing Company Inc. product catalogs may be found as a pdf titled "Dye Transfer Equipment Catalog Pages from Condit Mfr.," online at David Doubley's website, www.daviddoubley.com.
33. Condit Manufacturing Company, "How It Works" section in Film Punch product literature, unpaginated, copies in TIFP and Photograph Conservation Department, National Gallery of Art.
34. Penn was careful to select films with dimensionally stable polyester supports to make his enlarged films. See Penn 1977: "Registration of the several exposures is made possible through the use of dimensionally stable [Kodak] estar-base films."
35. An Eastman Kodak representative introduced Penn to direct-duplicating materials in response to his request for a "material to separate specular highlight from highlight area in large negatives." Eastman Kodak recommended Kodalith Duplicating Film, a direct-duplicating film that "can be developed to a continuous tone image" and "is used by many lithographers." Irving Penn, "Conversation with Mr. Cropp (E.K.)," handwritten notes, notebook A18, September 29, 1966, series XVI, box 181, folder 3, IPA. In addition to Kodalith Duplicating Film 2574, other direct-duplicating films used by Penn were Kodak High Speed Duplicating Film 2575 and Kodak Precision Line Duplicating Film LPD7.
36. Neblette and Sturge 1977, 29: "[A] direct positive (autopositive) emulsion is designed to produce a positive image with clear highlight tones upon chemical development rather than the customary negative image. This autopositive image is differently formed from the positive obtainable by 'reversal' development or by an image transfer method. . . . Direct positive emulsions can be based on well-known image reversal effects, such as solarization, Clayden, Villard and other effects." Early notes suggest that Penn also tested reversal development methods for producing direct-duplicate negatives, but this experimentation was short-lived due to the chemistry's rapid rate of exhaustion. Penn noted, "The only objection we see is the instability of the fogging developer; it must be freshly mixed almost for each run through." Irving Penn, "Direct Reversal Enlarged Negatives," notebook B4, April 30, 1965, series XVI, box 182, folder 5, IPA.
37. Rubylith was a red-colored masking film used in the graphic arts to prevent exposure of orthochromatic photosensitized materials.
38. For more information about sizing, see Cynthia Karnes, "The Art and Science of Papermaking for Platinum Photographs," in this volume.
39. Jones 1911, 495; Lietze 1888, 81–82; Wheeler 1930, 18; Anderson 1923, 198. See also Mike Ware, "The Technical History and Chemistry of Platinum and Palladium Printing," and Sarah S. Wagner, "Manufactured Platinum and *Faux Platinum* Papers, 1880s–1920s," in this volume.
40. Burbank 1887, 55–56.
41. Clerc 1944, 404–5.
42. Penn, "Sizing Test," handwritten notes, notebook C5, c. 1967, series XVI, box 184, folder 5, IPA.
43. Penn did not size his papers during the years author Zatse worked with him. A December 1, 1976, letter from the Penn studio to the platinum printer Wendy MacNeil indicates that Penn had abandoned sizing by that time. "Correspondence regarding technical questions and materials," 1976, series XVI, box 116, folder 3, IPA.
44. Penn, "Conclusions on Sizing," notebook B4, c. 1965, series XVI, box 182, folder 5, IPA. Invoices indicate Penn purchased USP grade gelatin and potassium aluminum sulfate (alum) and that a majority of his chemicals came from Amend Drug & Chemical, City Chemical, Fisher Scientific, and Pfaltz & Bauer. Invoices, 1964–98, series XVI, box 116, folders 2G–2L, IPA.

45. For an unnamed assistant's [probably Kurt Stier] notes describing sizing equipment and procedures, including instructional diagram of the sizing tank in use, see "Sizing," notebook A14, 5, c. 1971, series XVI, box 180, folder 7, IPA.
46. Walter Swarthout, "Mixing Gelatine for Sizing Arches & W. Teape," assistant's handwritten notes in notebook A19, c. 1968, series 16, box 181, folder 4, IPA.
47. Anderson (1923, 208) suggested that for multiple printing in platinum, "Some papers may need re-sizing before the second sensitizing."
48. Unnamed assistant [probably Kurt Stier], "Gelatin for Surfacing Prints," notebook A14, 36, March 26, 1971, series 16, box 180, folder 7, IPA.
49. Neblette 1942, 692–96.
50. See note 4 above. Anderson's formulas greatly influenced Penn's practice, and it is possible that Penn was familiar with Anderson's essays on hand-sensitized platinum and palladium papers: Anderson 1937; Anderson 1938. The latter is referenced in Neblette 1942, 695, which was among Penn's key references.
51. Penn, "Palladium, Basic Formula According to Neblette," notebook C5, 1967, series XVI, box 184, folder 5, IPA.
52. Penn, "Platinum Notes I.P.," 1–2.
53. Neblette 1942, 695; Anderson 1937, 692–94. The 1937 article by Anderson that describes in detail the drop method for platinum print sensitizing is among the photocopies requested by Penn from the New York Public Library (see note 4 above) and is the article to which Neblette 1942, 695, refers. Penn also had a copy of Henney and Dudley 1939 in his library, which includes an entry by Anderson that provides the same platinum sensitization instructions, including the drop method. Anderson 1934, 157, which was among the photocopied references received by Penn in June 1964, uses minims instead of drops to indicate quantities of each solution. See also Matthew L. Clarke, "Characterization, Degradation, and Analysis of Platinum and Palladium Prints," in this volume.
54. In printing records for his *Small Trades* series, Penn wrote that 3 drops of ox gall added to sensitizer for coating one sheet of paper has "no appreciable spreading difference." Penn, notebook B2, 1967, series XVI, box 182, folder 3, IPA. Several 1 oz. bottles of Winsor & Newton ox gall remain in Penn's chemical cabinet in Lab A. There is also a receipt for 100 gm of ox bile from Pfalz & Bauer Inc. (description code 003985), November 4, 1975, TIFP.
55. Penn, "Platinum Notes I.P.," 2.
56. See note 53 above.
57. Penn, "Actual Printing of Workmen Series," notebook B2, 1967, series XVI, box 182, folder 3, IPA.
58. Penn, "Platinum and Palladium Combination Notes," notebook C5, 1967, series XVI, box 184, folder 5, IPA.
59. Penn, "Notes after a period of work . . ." c. 1975, typescript 1998, 2, series XVI, box 116, folder 6G, IPA.
60. Wall 1923, 7. Thanks to Mike Ware for drawing the authors' attention to this article.
61. Examples include Arentz 2005; Crawford 1979, 168–69; James 2016, 298–347. See also Tatiana Cole, "The Platinum Renaissance: Oral Histories of Platinum-Palladium Printers and Artists," in this volume.
62. Penn 1991, 144.
63. Penn tested both pressure-sensitive and gummed paper tapes for masking the paper without causing damage to the sheet's surface. In author Zatsé's laboratory sessions with Penn, 1996–99, 3M Scotch 230 Drafting Tape was used.
64. Penn, "Notes after a period of work," 4.
65. Penn, "Notes after a period of work," 2.
66. "New Lamp" 1958.
67. "Ascorlux Sales Manual: Series 1100 Data Sheet," American Speedlight Corporation, September 15, 1963, issue 6, 13. This and other Ascorlux documents are among equipment and chemical catalogs in Lab A.
68. Penn, "Platinum Notes I.P.," 3.
69. This feature appears to be Penn's design as it is not listed or illustrated in the Ascorlux sales manual cited in note 67.
70. Penn, "Platinum Notes I.P.," 3.
71. Penn 1977.
72. Penn, "Platinum Notes I.P.," 2.
73. Penn 1977.
74. The tapes used for this purpose were 3M Electroplating Tape 470 and 3M Vinyl Tape 471. See the data sheets at the 3M website, www.3m.com.
75. Penn used analytical reagent grade hydrochloric acid.
76. Platinum and palladium developer: Walter Swarthout, "Mixing Plat Developer," assistant's handwritten notes, notebook A19, c. 1968, series 16, box 181, folder 4, IPA; clearing bath: Walter Swarthout, "Mixing Hydrochloric Acid Solution for Plat Printing," assistant's handwritten notes, notebook A19, c. 1968, series 16, box 181, folder 4, IPA; bleaching bath (c. 1969): Keith Trumbo, technical notes on the use of sodium bisulfite as a bleaching agent, notebook A21, 6, July 2, 1969, series XVI, box 181, folder 6, IPA; bleaching bath (c. 1994): adapted from Penn's handwritten notes adhered to the drying cabinet in Lab A.
77. Penn, "Notes after a period of work," 4.
78. Penn, "Notes after a period of work," 1.
79. Penn, "Notes after a period of work," 1.
80. Yellow sensitizer in sodium bisulfite as an "extraordinary discovery!" General notes on platinum in notebook B4, c. 1965, series XVI, box 182, folder 5, IPA.
81. Based on author Zatsé's laboratory sessions with Penn, 1996–99.
82. See Keith Trumbo's technical notes on the use of sodium bisulfite as a bleaching agent, notebook A21, 6, July 2, 1969, series XVI, box 181, folder 6, IPA; Penn, "Notes after a period of work," 4.
83. Based on Zatsé's laboratory sessions with Penn, 1996–99.

84. Penn, "Notes after a period of work," 1.
85. Unnamed assistant [probably Kurt Stier], "Permanence and durability of the Platinum Print," notebook A14, 18, September 1971, series XVI, box 180, folder 7, 18. IPA.
86. Unnamed assistant [probably Kurt Stier], "Permanence and durability," 19: "A paper is considered stable and archivist quality if it has a pH somewhere between 7.2–8.5.
87. Unnamed assistant [probably Kurt Stier], "Permanence and durability," 19–21.
88. United States Testing Company Inc., "Report of Test," December 6, 1971, series XVI, box 180, folder 7, IPA. Penn worked with the paper services division of this independent Hoboken, New Jersey, firm to subject samples to aging tests to determine if deacidification was a safe procedure for his prints.
89. Unnamed assistant [probably Kurt Stier], "Permanence and durability," 21. This notebook records Penn's research into deacidification using the following terms: magnesium spray (page 19), calcium two shot (page 20), and magnesium one shot (page 21). For descriptions of related deacidification methods, see Barrow 1964, 19.
90. Cunha 1971, 382–83.
91. Keith Trumbo, "De-acidification," notebook A21, 47–69, May 1972–March 1973, series XVI, box 181, folder 6, IPA. By March 1973, approximately 1,100 previously printed plates and 940 paper prints were deacidified.
92. Trumbo, "De-acidification.
93. In addition to trimming the excess paper and Surlyn at the sides and bottom of the plates, in later years Penn removed the bare aluminum strip with punched holes at the top.
94. Walter Swarthout, "Steps in loading Plat Prints into drier in country," notebook A19, series XVI, box 181, folder 4, IPA.
95. Penn 1977.
96. Whether Rives BFK or Bristol was used for *Sitting Man with Pink Face* was not specified.
97. Penn stopped printing his photographs in platinum-palladium in 1999 but continued to make platinum-palladium prints of his drawings through the summer of 2000.
98. Penn 1991, 144.
99. Penn, "Platinum Notes I.P 2."

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Appendix A

Diagram of Irving Penn's Process for Making Enlarged Prints from Original Camera Negatives*



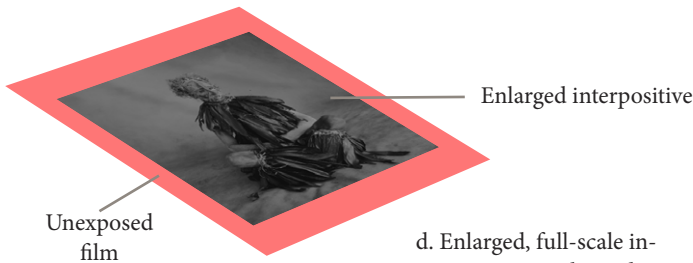
a. Original camera negative emulsion down (correct reading) placed in enlarger.



b. Image projected to desired size onto unexposed sheet film.



c. Enlarged interpositive, emulsion up (correct reading).



d. Enlarged, full-scale interpositive, emulsion down (backward reading) in contact with unexposed sheet film.



e. Enlarged, full-scale duplicate negative, emulsion down (correct reading).

Making an enlarged full-scale black-and-white negative from an original full-color camera positive

An original full-color camera positive (f) is placed in an enlarger emulsion up (backward reading) (g). The image is projected to desired size onto unexposed black-and-white sheet film that has been placed emulsion up on a vacuum frame (h). The exposed film is then developed, resulting in an enlarged, full-scale negative (i).



f. Original full-color camera positive emulsion down (correct reading).



g. Original full-color camera positive emulsion up (backward reading) placed in enlarger.



h. Image projected to desired size onto unexposed black-and-white sheet film.



i. Enlarged, full-scale negative, emulsion down (correct reading).

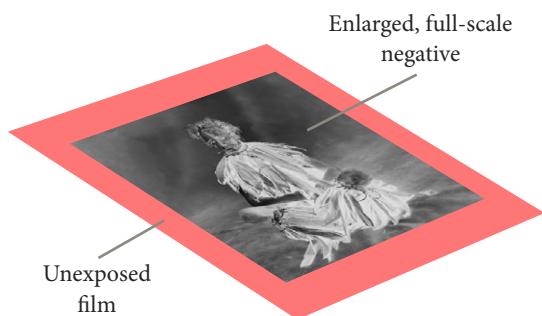
*Note: The "original camera negative" shown here is for illustration purposes only; the camera original used was actually a positive color transparency (see fig. 12).

Making negative printing masks by direct contact from an enlarged, full-scale negative

An enlarged, full-scale negative (j) is placed emulsion down (correct reading) in contact with a sheet of unexposed sheet film (k) that has been placed emulsion up in a vacuum frame and exposed with a point light source. The exposed film is then developed, resulting in a negative printing mask. This process is repeated for each successive mask that is desired (l).



j. Enlarged, full-scale negative, emulsion down (correct reading).



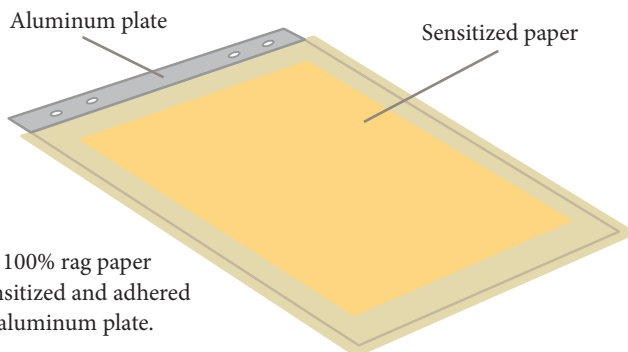
k. Enlarged, full-scale negative, emulsion down, in direct contact with unexposed sheet film.



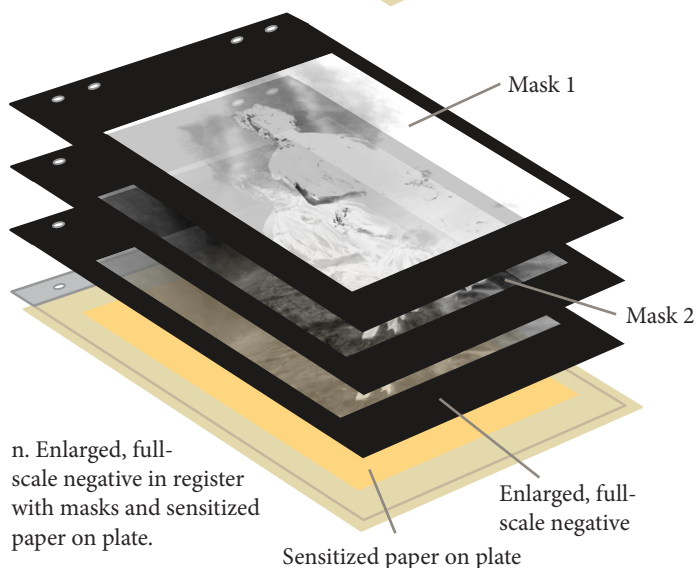
l. Two negative printing masks: specular (left) and overprinter (right).

Making a finished print using an enlarged, full-scale negative and registered negative masks

A sheet of 100% rag paper sensitized with a platinum/palladium solution is adhered to an aluminum plate (m), then placed in a vacuum frame. The enlarged full-scale negative is registered with negative masks (edges masked to provide a clean print border) and placed emulsion down in contact with the sensitized paper (n). Vacuum is drawn, and a xenon arc lamp exposes the print. The print is then developed, cleared, washed, deacidified, and dried (o).



m. 100% rag paper sensitized and adhered to aluminum plate.



n. Enlarged, full-scale negative in register with masks and sensitized paper on plate.



o. Finished print with edges of paper trimmed.

Appendix B

Diagram of Worksheet for Sitting Man with Pink Face

This diagram of the worksheet should be studied in conjunction with tables 1 and 2 and appendix A, which provide details regarding the films, negative combinations, and sensitizer formulas Penn used to make his platinum-palladium prints. Explanations that accompany key sections of this worksheet explain the codes and abbreviations for the sensitizers and film and provide an aid for the interpretation of Penn's shorthand. Together, the tables and this figure are meant to provide a general sense of his working process.

The alphanumeric codes and corresponding components of the sensitizer used for *Sitting Man with Pink Face* include:

- A = Platinum solution, containing potassium tetrachloroplatinate(II)
- 3-2X = Palladium solution (double strength), containing sodium tetrachloropalladate(II)

- 2 = Ferric oxalate solution, also containing potassium chlorate
- 2H = Ferric oxalate solution, also containing twice the amount of potassium chlorate for increased contrast
- W = Water

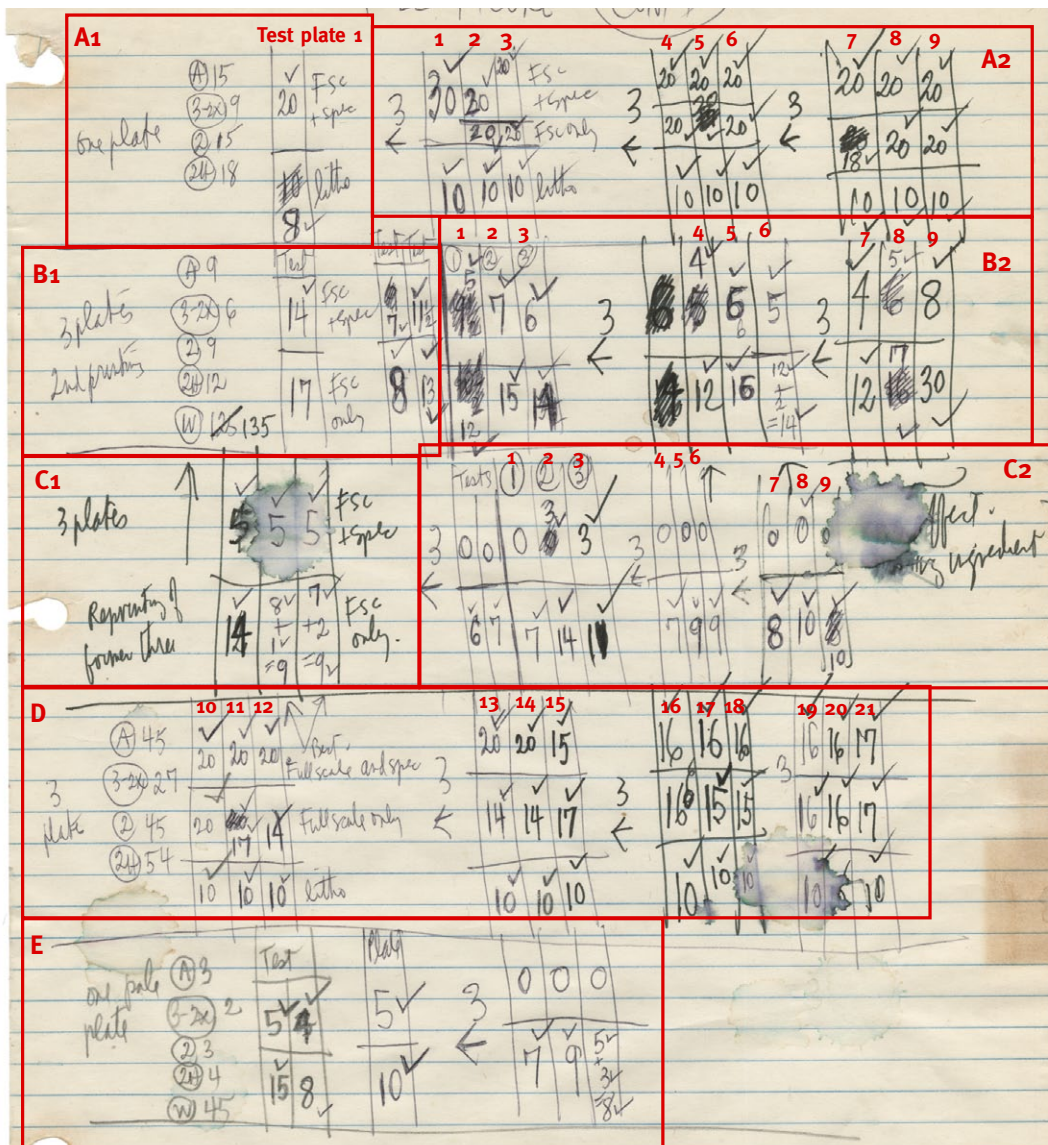
A1

A test plate was sensitized with 57 cc of the standard full-strength formula:

A: 15 cc
 3-2X: 9 cc
 2: 15 cc
 2H: 18 cc
 Total: 57 cc

The 57-cc volume of sensitizer may seem to be a very large amount of solution to sensitize a 406 square-inch (~2619 square cm) area, which is similar to the image area of *Sitting Man with Pink Face* in the collection of the National Gallery of Art. While generous, tests performed on a mockup of a similarly prepared and mounted sheet of Strathmore 500 drawing paper confirmed that a full 57 cc of dyed water could be coated on the sheet.

The test plate was then exposed in contact with two negatives: both a full-scale negative (FSC) and a specular mask (Spec)



Detail of worksheet for *Sitting Man with Pink Face*, 1979–80 (fig. 17).

together in a 20-minute exposure. The pair of negatives was then removed, and the same plate was exposed with a high-contrast negative (“litho”) for 9 minutes. A check mark (✓) indicates the exposure session was complete. The plate was then processed (developed, cleared, washed) and air-dried.

A2

The printing record indicates that Penn used the **test plate** as a starting point. The “3” with an arrow (←) below indicates that the following table (grids of numerals in six to nine cells) represents one printing session in which three plates (**1, 2, and 3**) were sensitized in the same way as shown in **A1**. Each table records the exposures of three plates for the times shown in each column (with exposures varying from plate to plate). The numerals in each cell indicate the minutes of exposure. For example, **plate 1** was first exposed in contact with both the full-scale and specular negatives together (“FSC + Spec”) for 30 minutes, then with the high-contrast negative (“litho”) for 10 minutes. **Plates 2 and 3** were exposed with the full-scale and specular negatives (“FSC + Spec”) for 20 minutes, followed by the full-scale negative only (“FSC only”) for an additional 20 minutes, and subsequently with the litho negative for 10 minutes each. Again, a check mark (✓) indicates that each exposure was complete and the plate was processed.

After Penn was confident that he had achieved the proper sensitization, negative choice, and exposure combination, he went on to sensitize and expose **plates 4–6** and **plates 7–9** similarly in two subsequent sessions. The exposures for **plates 4–9** were standardized with exposures similar to **plate 2**. Following the completion of each series of exposures, the plates were processed and dried. Once dry, the plates were inspected to determine if additional sensitization was necessary. In summary, **plates 1–9** were sensitized in groups of three, all with the same platinum-palladium formula, but were exposed with different negative combinations and exposure times.

B1

After **plates 1–9** were dry, Penn examined them to judge what additional tonal information might be required and to determine how these plates should be re-sensitized and re-exposed. In order to fine-tune the image tones achieved in the first printing (“underprinting”), in this case to augment the highlight detail and shadow density, Penn re-sensitized the plates with a diluted version of the sensitizer used for the first printing:

A:	9 cc
3–2X:	6 cc
2:	9 cc
2H:	12 cc
<u>W:</u>	<u>135 cc</u>
Total:	162 cc ÷ 3 = 54 cc per plate

Penn returned to the **test plate** shown in **A1** (as indicated by the continuation of the column), re-sensitized it using the dilute formula shown in **B1**, exposed it for 14 minutes with the FSC and Spec negatives followed by 17 minutes with FSC only. He then processed, dried, and inspected it. Two more tests prints were made, possibly on sheets of unmounted paper. One test was exposed for 7 minutes with the FSC and Spec negatives followed by 8 minutes with FSC only, the other one exposed for 11½ minutes with the FSC and Spec negatives followed by 13 minutes with FSC only.

B2

Following the three tests using the dilute sensitizer to determine the proper exposure to provide additional tonal information, **plates 1–3** were re-sensitized with the same dilute sensitizer as the **test plate** and exposed as shown in each column. Once the sensitization and exposure combination was satisfactory, **plates 4–6** were re-sensitized, exposed, and processed in another session, and **plates 7–9** were re-sensitized, exposed, and processed in a third session. Again, the “3” and the arrow (←) indicate that each set of three plates was prepared similarly to those of the preceding session. A variety of exposure combinations was used, with the exposure time in minutes noted in the grids, as described in **A2**. For the second printing (or “overprinting”), however, only two exposures were used: the first with the full-scale and specular negatives together (FSC + Spec), then with the full-scale negative alone (FSC only).

C1

To further fine-tune the quality of his prints, Penn sometimes re-sensitized and re-exposed the same prints yet again. In this example he used the same dilute sensitizer as shown in **B1**, as indicated by upward arrow (↑) and the annotation, “3 plates / Re-printing of former three.” Three more tests followed, which were re-exposed with the negatives and times as shown in the table.

C2

Plates 1–9 were re-sensitized with the dilute sensitizer and re-exposed as shown in the columns of each table, first using the combined full-scale (FSC) and specular (Spec) negatives followed by the full-scale negative only. **Plates 1 and 4–9** were not re-exposed to the specular negative as indicated by the number “0” at the top of each column. Penn also made two tests prints in a manner similar to those described in **B1** above.

D

Plates 10–21 represent an entirely new set of plates and printing sessions (“first printing” or “underprinting”), and were sensitized with the same full-strength formula shown in **A1**, using three times the quantity of components used for the single **test plate**.

A:	45 cc
3–2X:	27 cc
2:	45 cc
<u>2H:</u>	<u>54 cc</u>
Total:	171 cc ÷ 3 = 57 cc per plate

As was done for **plates 1–9**, **plates 10–21** were sensitized and exposed in groups of three. Each plate was first exposed with the full-scale (FSC) and specular (Spec) negatives together, followed by a second exposure with full-scale only, and finally with the litho negative, each according to the time indicated in the table.

E

Exactly what these notes represent is not clear, but they describe two tests and four plates using the same dilute sensitizer described in **B1** and exposures similar to those described in **C2**. It is probable that these notes represent one test plate and three of the twelve plates shown in **D** that were re-sensitized, exposed, and processed.