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Author(s): Katrin Pietsch
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Flattening Rolled Negatives on Filmbase

Katrin Pietsch

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Abstract

Medium format and 35 mm photographic negatives are frequently archived by photographers in uncut and rolled form. That storage solutions designed specifically for housing rolled negatives were sold shows how common this way of storing negatives has been. Several reasons, which will be outlined in this paper, can lead to the decision to flatten these films.

Over the last 8 years the author developed a treatment method to flatten photographic negatives on cellulose nitrate and acetate bases, which will be presented in this paper. In 2014 this method was evaluated and standardized during two large negative treatment projects.

As part of her thesis in 2007, the author started to research this problem and developed a treatment to flatten films. The chance to apply the lessons learned and techniques developed during this thesis work arose during the next seven years, when the author was working a photograph conservator at the Nederlands Fotomuseum. In 2014 there was yet another opportunity to revisit these methods as two major projects involving rolled film came into the studio.

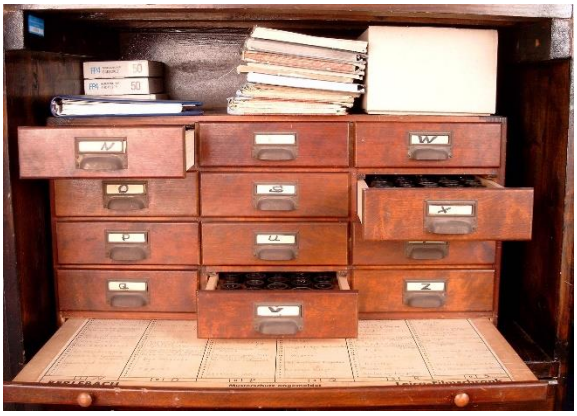
This paper will outline the testing undertaken and methodology developed as part of the author's thesis work, and several case studies will be presented. Special attention will be given to the fact that batch treatment projects often allow a more thorough evaluation of a treatment protocol. The author was able to improve both the quality of the treatment and the workflow efficiency during two large-scale projects undertaken at the Nederlands Fotomuseum.

Rolled Negatives on Cellulose Nitrate and Acetate

Many professional photographers kept their film negatives uncut (and therefore rolled up) after processing. This practice was so common that the market even offered storage systems, like boxes and cabinets, to house rolled films. It was a simple and convenient way for photographers to keep their films stored. Decades later we are now confronted with problems related to this way of storing film material. The films have aged, becoming brittle, and the curled form becomes more rigid. They cannot be unrolled without great risk of breaking. Beside problems regarding the handling and accessibility of such photographic negatives, there are also some issues concerning the stability of the material itself.

There is evidence that a tightly rolled film will degrade much faster than an unrolled film due to the greater accumulation of degradation gasses in the rolled film. The accumulation will catalyse and accelerate the aging of the film base and the emulsion. This is true for both cellulose nitrate and acetate films.

Due to this inherent vice, rolled film will become even more brittle and shrunken than the same type of negative stored flat. The changing physical and chemical characteristics of the rolled film will become even tighter over time.



Figs. 1 and 2. Cabinet *(left)*, made by Leica; containing drawers *(right)* for the storage of negatives rolls, Stiftung Stadtmuseum Berlin

In addition to these aspects of materiality and aging, the limited accessibility of a film roll is a further risk to the negatives. Because of the tension within the negative, there is a greater chance of breaks during handling or digitization. Attempting to avoid this risk, the access to the material will be limited.

Developing a Method to Flatten Rolled Negatives

2007: Thesis

The first time that the author was presented with the question of how to approach rolled negatives came, she was writing her thesis at the HTW Berlin in 2007. The Stiftung Stadtmuseum Berlin was in possession of an archive of about 1,000 35mm films on cellulose nitrate and acetate by photographer Harry Croner. The archive was donated to the Stiftung Stadtmuseum Berlin by the photographer in its original state, which dates from the 1940s to 50s.

The purpose of the thesis was to develop a methodology which would allow to access the images and to enhance the long term stability of the films. The main steps of this would be scanning, flattening, and storing the original films.

A thorough literature review on the topic was conducted. Combined with interviews of colleagues with past experience attempting various flattening methods, or who had ideas on the topic, lead to a short list of treatment protocols with which to experiment. The basic idea was to use some type of aqueous treatment to make the films flexible and to then to dry them hanging, with weights at the bottoms. Some protocols also added other components, such as glycerine, to compensate for the loss of plasticizer from the film base, intending to make the films more flexible for the long term.

Some test material was treated with what appeared to be the most promising methods. None of them worked properly because the films never reached a point where they were flexible enough to properly flatten. Upon unrolling the test films, it often it felt as if stretching them could cause them to break, and even after being dried hanging with weights the films would pop back into their original rolled form. It seemed that humidifying a roll of film did not allow the moisture to reach the core of the film, keeping the material too stiff to take up a new form.

The next approach was to prolong the film's exposure to moisture, trying to get the water deeper into the structure of the films.

Humidification was done in long vertically-hung plastic bags, which allowed the film to be stretched out over the course of the treatment. Salt solutions placed at the bottom of the bags stabilized the relative humidities within the bags. The film was placed into the humidification bag and, when relaxed, unrolled with the help of a light weight attached to the bottom of the film. After further humidification, the film was left hanging with a weight during the drying process. This technique did permanently stretch out the films, but had two major disadvantages.

Unrolling the film bit by bit, with a weight a one end, before it has been completely humidified does risk breaking the film. Also, letting the film hang to dry, again with a weight at the bottom, causes some deformation of the film: films unrolled and dried in this way developed a halfpipe shape.

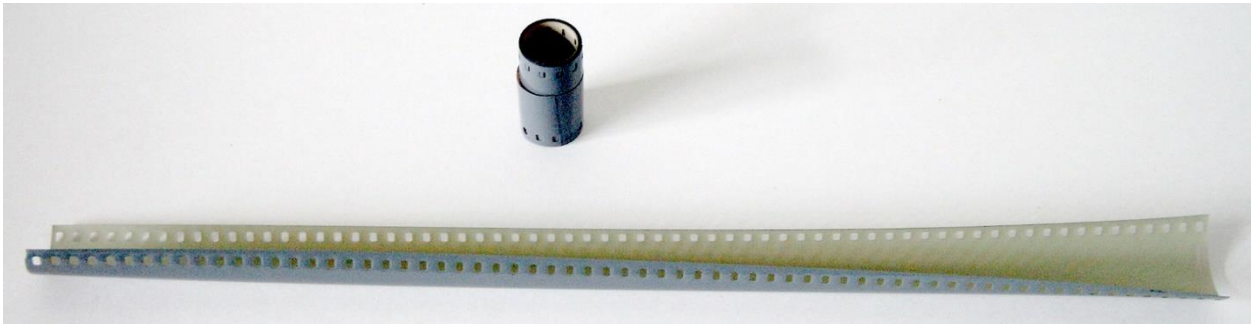


Fig. 3. Test film before *(above, rolled)* and after vertically-hung humidification and weighted drying *(below, unrolled)*.

To overcome those disadvantages the method was adjusted as follows:

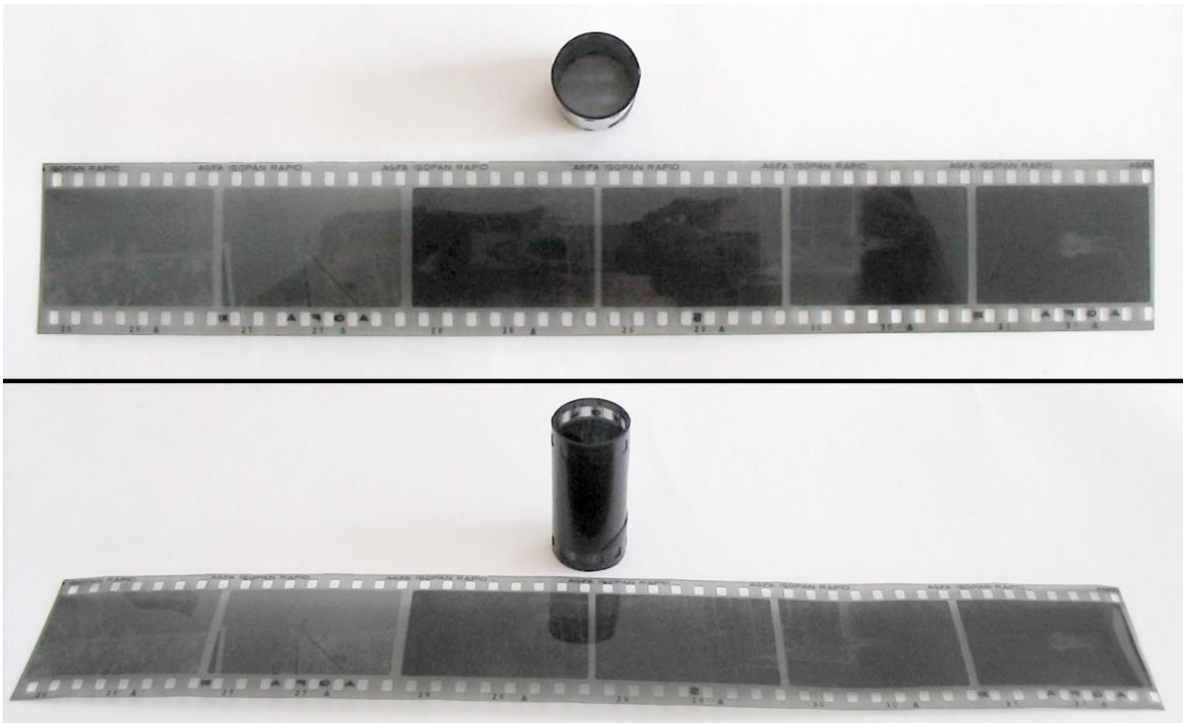
- The negatives were wound onto conventional film developing reels in the direction of the curl. Using the developing reels put minimal mechanical stress of the films while ensuring that the entire length of the filmstrip could be evenly humidified.

- The loaded film reels were then placed into individual humidification chambers. Once the films reached a certain degree of relaxation they were taken out for drying.

- The negatives were dried wound onto a larger diameter film core, oriented so that the original direction of the curl was reversed. The film was the wrapped in a layer of nonwoven polyester and then blotting paper, to absorb any residual moisture. The negative would be left drying for some days in this configuration.

Figs. 4 and 5. Films wound onto developing reels in humidification chambers *(left)*; onto a larger-diameter film core for drying *(right)*

These adaptations produced satisfying results for both cellulose nitrate and cellulose acetate negatives. The films were completely and evenly flattened. After treatment, the flattened test films were kept loosely in a box, in several locations with variable climates. Eight years later their condition is unchanged: the original curl did not reappear.



Figs 6 and 7. Test films before and after the modified treatment protocol; pictured from above *(top)* and at an angle *(bottom)*

Unfortunately, due to a lack of finances, the project for the Croner archives that the treatment methodology was devised for was never undertaken. As the treatment protocol was never tested using actual collection materials, it was unclear if it was suitable for original films. Also, the thesis work did not allow for the development of a batch-treatment protocol, which seemed crucial for a large collection such as the Croner archives.

2014: Project Paul Julien

The Nederlands Fotomuseum holds about 800 films by photographer Paul Julien, taken in the 1930s, 40s and 50s on African expeditions. All of the negatives are black and white, 120 medium-format, and include both cellulose nitrate and acetate films. The Fotomuseum received the films as Julien stored them, wound up in tight rolls, wrapped in papers with hand written descriptions.

In 2014 artist Andrea Stultiens, doing research for her own work, became interested in working with images from this collection. The museum had to tell her that, unfortunately, the material wasn't accessible: it had never been scanned and that the fragile state of the films precluded any handling by researchers. The museum itself did not have the financial means to treat the films.

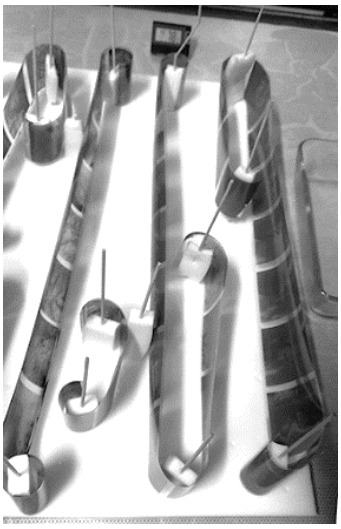
In order to access the images, Stultiens decided to spend part of her research budget to treat and digitize selected film rolls, stating a project in which 500 rolls would be flattened and digitally imaged.

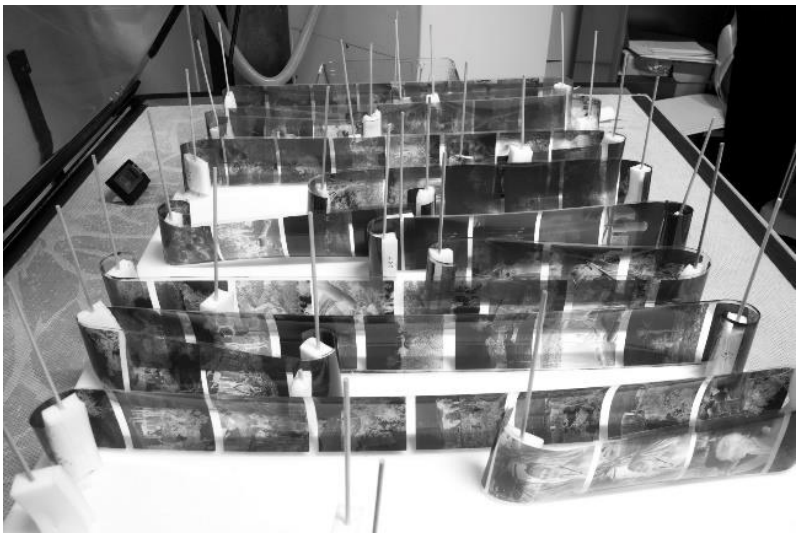

Figs. 8, 9 and 10. Box with rolled films from the Paul Julien archive *(left)*; film with a paper wrapper *(center)*; film without a paper wrapper *(right)*

This project would allow for the developed treatment method to be refined. It was also important to devise an efficient workflow so that the 500 selected films could be treated within a reasonable timeframe.

While it was certainly possible to treat several films at the same time within a conventional humidification chamber, in the previous thesis test series the rigidity of the film rolls meant that it was occasionally necessary to force the film into the development reel in preparation for humidification. With the Paul Julien negatives, the aim was to enable total humidification in a more flexible way. The desired approach would be to extend each film roll to a greater or lesser degree, depending on the extent to which a film was curled, and for the roll to be gradually opened as the film base became more flexible. The film holder should be adjustable, to perfectly fit the curl of the film each time. The solution to this problem was extremely low tech.

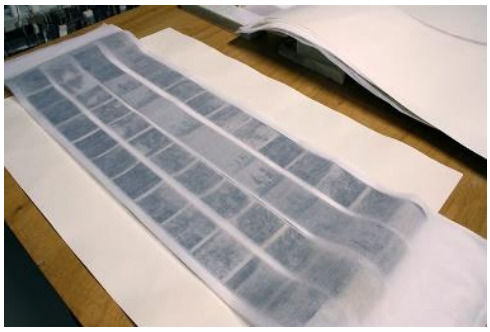
The rolled negatives were slowly unrolled and held in place with movable supports made from Ethafoam and bamboo skewers. The skewers were secured to a larger Ethafoam base within the humidification chamber. Up to twelve rolls of film could be humidified at once.





Figs. 11 and 12. Multiple rolls of negatives are humidified at once; held in place with a moveable Ethafoam and bamboo skewer system

After several hours of humidification the films were sufficiently relaxed. They were removed from the humidity chamber and sandwiched between sheets of nonwoven polyester fabric and blotting paper. The whole package was oriented so that the original direction of the curl was reversed and rolled around a paperboard tube, secured, and dried for several days.



Figs. 13 and 14. Film sandwiched between nonwoven polyester fabric and blotting paper; rolled for drying around a large-diameter paperboard tube

This treatment method was very successful. The film negatives were flattened to a satisfactory degree and could be handled without any notable degree of risk.

Fig. 15. Two stacks of films after treatment

As part of this project, the collection managers decided to cut the films and house them in polyethylene negative sleeves. This was deemed acceptable for several reasons. The order of the rolls and images was well-documented; the risks involved in scanning and storing the long, thin strips of film were great; and the films needed to be scanned in an efficient manner. For this project, each sleeve of negatives was scanned with a high resolution camera on a light table. After scanning the individual images were digitally separated, enabling research.

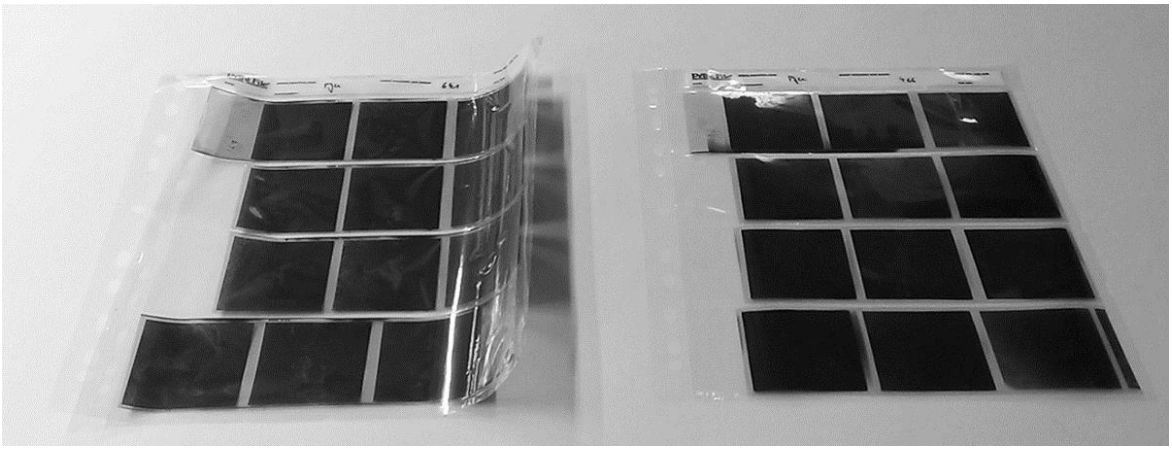


Fig. 16. Cellulose acetate film *(left)* and cellulose nitrate film *(right)* after treatment

During the treatment, it was found that there were a few differences in the behavior of cellulose nitrate and cellulose acetate negatives. The cellulose nitrate films were more reactive to the humidification than the cellulose acetate. The nitrate films also remained perfectly flat after drying while some of the acetate films showed a slight tendency to curl after treatment. The slight curling occurred with a very small number of films, all of which were cellulose acetate, and could be due to insufficient humidification. The thicker acetate base material may require longer humidification times than nitrate materials do.

Apart from the treatment of a significant portion of the Paul Julien archive, this project also resulted in an improved treatment method for rolled negatives, optimized for a large number of films.

2014, Project Cirkut negatives

Around the same time as the Paul Julien project, another Dutch Archive, the Stadsarchief Breda (City Archive of Breda), contacted the conservation studio at the Nederlands Fotomuseum requesting the treatment of a collection of 22 Cirkut camera negatives. The negatives are all 25 cm in height but vary in length; the longest is one meter long. All are on a cellulose nitrate support that is significantly thicker than the film supports of a 120 type film.

The negatives were taken by a press agency in the 1930s and 40s. After development and printing, the original negatives were rolled and put back into their original boxes. The archive received them tightly rolled up, preventing access to the content.

Assured by the positive results of the Julien project, the studio accepted the project and developed a treatment plan for the collection.

Figs. 17 and 18. Negatives housed in the original Kodak boxes (left); film's tendency to curl

As with the Paul Julien archive, the Cirkut camera negatives were placed in the humidification chamber, held in place by Ethafoam / bamboo skewer unrolling system. The placement of the bamboo skewers was dependent on the degree to which each film was curled. Humidification took several hours, and as soon as the negatives relaxed enough they were taken out for drying.

Fig. 19. Multiple Cirkut negatives placed into the Ethafoam / bamboo skewer unrolling system in preparation for humidification

The negatives were sandwiched between sheets of nonwoven polyester fabric and blotting paper, oriented so that the original direction of the curl was reversed, rolled around a paperboard tube, and left to dry for several days. As with the previous treatments, the curl was completely reduced and, when unrestrained, the negatives remained flat.

Fig. 20. Flattened panoramic negative immediately after drying

After flattening, the negatives were digitally imaged in order to increase their accessibility. The archive was finally able to identify and research the content of the images. An exhibition of the photographs opened in October 2015.

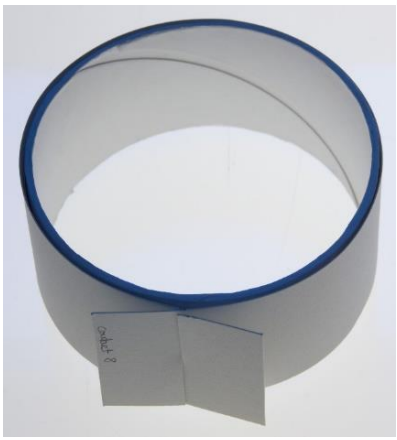
Fig. 21. One of the Cirkut negatives after digital imaging

The quality of the images is extraordinary; the images are highly detailed and the exposures incredibly uniform. It appears that these negatives were barely used, that after the first printing they were put back into the film boxes and directly into storage. Only a few examples show any signs of deterioration, most of which are stains caused by adjacent items such as oxidized paperclips or tapes.

Some Ideas on the Storage of Rolled Films

It might not always be possible to flatten rolled film negatives. In 2010, the conservation studio the Nederlands Fotomuseum was unable to flatten at a group of approximately 600 negatives. This was primarily due to budgetary constraints, especially as the films had an uncertain juridical status at the time. (Investigations into potential scholarly interest in the collection are ongoing.) Until the degree of interest is determined and a treatment project initiated, the films required an improved storage method, one that would minimize the negative effects of being stored in tight rolls. A suitable storage design was developed.

Each film was rolled around a 5 cm diameter acid-free paperboard tube. A long strip of PAT-certified paper prior was used to wrap the paperboard core and as interleaving as the film was rolled. A piece of lightweight cardstock was attached to the end of the interleaving paper: this cardstock was used as an outer covering for the roll and to secure the closure.

Figs. 22 and 23. Negative rolled onto to a large-diameter tube; a wrapped and secured film

The large diameter of the paperboard core will hopefully allow the film to relax into a less tightly-curled shape, so that any future unrolling opening will be with less risky. As there is evidence that a tightly rolled film will degrade much faster than an unrolled film, a larger diameter core will also reduce the degree to which the film is degraded. The additional of the paper interleaving should also provide from buffering effects for a period of time.

The rolled and secured negatives were placed into customized commercially available boxes. Each box was modified by placing an alkaline cardboard grid into the base, allowing twelve rolled negatives to be stored within it. To avoid any shifting of the rolls within the box, a sheet of heavyweight paper was secured to the bottom of the box and was cut and folded to make simple holders for each roll.

Fig. 24. A customized box filled with empty rolled negative holders

This housing system can be a good solution for storing an archive of rolled film if it is not possible to humidify and flatten the films. However, the major drawback of this housing system is that the volume of storage space taken up is dramatically increased, especially for collections containing hundreds of rolled film negatives.

Conclusions

Although the treatment protocol is very effective and the results highly satisfying, it would be beneficial to look more closely at some aspects of the flattening method to better understand any resulting long-term effects. In 2007, as part of the author's thesis work, pH measurements of the sample films were taken before and after treatment. No evidence of increased free acids was noted, and it was assumed that degradation of the films was not accelerated by the humidification process. Other mechanical properties of the films could be measured before and after treatment, and ideally after accelerated aging as well. Future work also includes the development of a workflow that allows for an even greater treatment capacity. The Paul Julien archive project had a maximum of 40 to 50 films a day.

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Katrin Pietsch
Photograph Conservator
Nederlands Fotomuseum,

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