The Dutch Method Unfolded II

Masterclass on Wax-Resin Lining
University of Amsterdam

WORKSHOP GUIDE

Amsterdam
22-31 January 2025

Contents

Introduction

This document was created for the participants of the masterclass the Dutch Method Unfolded II as a guide for the practical workshops part of the program.
It contains background information on the workshops and their organization, material and technical information on the test samples, descriptions of the lining procedures, practical recommendations regarding the use of the equipment. It also includes visual documentation of the test samples involved in the workshops.
This document is the first version of the report that will be handed in to the participants after the masterclass has taken place. The second version will be updated with the photographs of the test samples made after wax-resin impregnation. Furthermore, corrections will be added if necessary, according to what happened during the practical sessions.
The document was created by Emilie Froment in collaboration with Madeleine Vaudremer (editing). Jerome Schlomoff did all the photographs of the reconstructions presented in this report unless the ones for workshop I and the figure 1 for the workshop II.

Workshop I
Technical examination of various lined paintings

1. Organizational details

Supervised by: Emilie Froment
Collaboration: Meghan van der Drift, Kathleen Morgan, Varin Marthinsson, Madeleine Vaudremer
Dates: 22 January 2025
Location: *Ateliergebouw*, Amsterdam

2. Goals of the workshop

Technical examination of 6 paintings currently under treatment at the UvA. The session is accompanied by the students in charge of the restoration of the paintings. The goal is to get familiar with the characteristics of the traditional approach to wax-resin lining as implemented in the Netherlands until the 1970s. The exchange of knowledge between professional conservators and students will benefit both parties.

3. Teaching methods

In small groups each participant will study the condition of the paintings presented in the studio with the means of strong day light, magnifiers, and UV. There are also technical images available, such as xrays and cross-sections.

Group 1: Meredith, Paula, Ioseba.
Group 2: Saki, Joana, Elizabeth.
Group 3: Agnieszka, Özer, Julia.
Group 4: Matthew, Rosie, Andras.
Group 5: Marie-Hélène, Markus, Marianna.

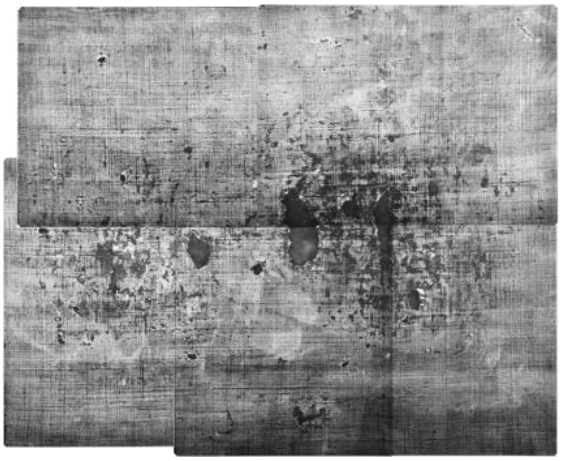
4. The paintings

4.1 Seascape - Presented by Madeleine Vaudremer

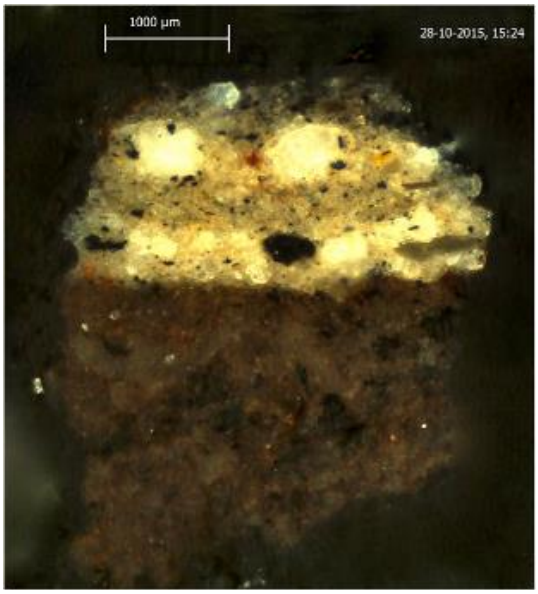
Title: *Seascape*
Attribution: Willem van de Velde the Younger
Date: ca. 1655
Technique: Oil on canvas
Dimensions: 64.5 x 78.0 x 2.5 cm
Owner: Koninklijke Wessanen N.V.

Recto before treatment

Verso before treatment



Stitched X-radiographs. Author: Gwen Tauber (formerly Rijksmuseum)

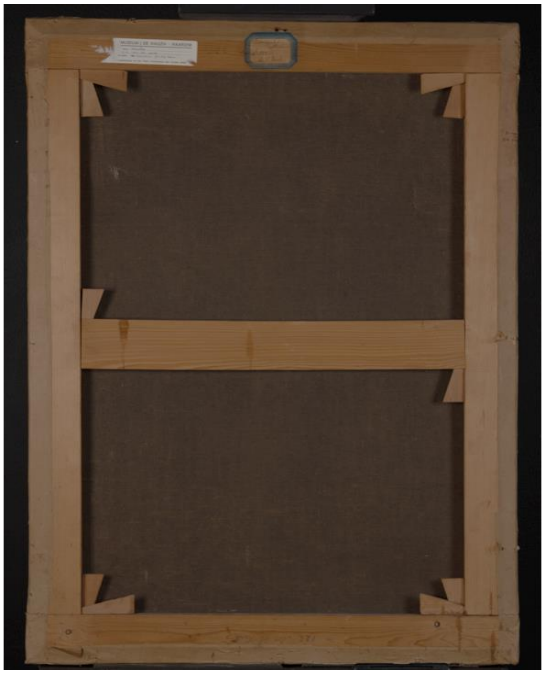


Cross-section in visible light from the lower edge of the painting, 9.8-10 cm from the left

4.2 Grisaille - Presented by Kathleen Morgan

Title: Personification of the church
Attribution Johannes Petrus van Horstok / Signed JP v Horstok
Date 1795
Technique: oil paint on canvas
Dimensions: 91 x 64 cm without frame
Owner: Catharijneconvent Museum, Utrecht
Provenance: Donation in 1810
Inventory number: BMH S122


Recto before treatment


Verso after cleaning

4.3 Mary and sleeping Christ child - Presented by Kathleen Morgan

Title: Mary and sleeping Christ child
Attribution unknown
Date c. 1700-1749
Technique: oil paint on canvas
Dimensions: 75x56 without frame
Owner: Catharijneconvent Museum, Utrecht
Provenance: 1976 Rijksmuseum The Catharijneconvent
Inventory number: BMH S3978

Recto before treatment

Verso after cleaning

Xradiograph

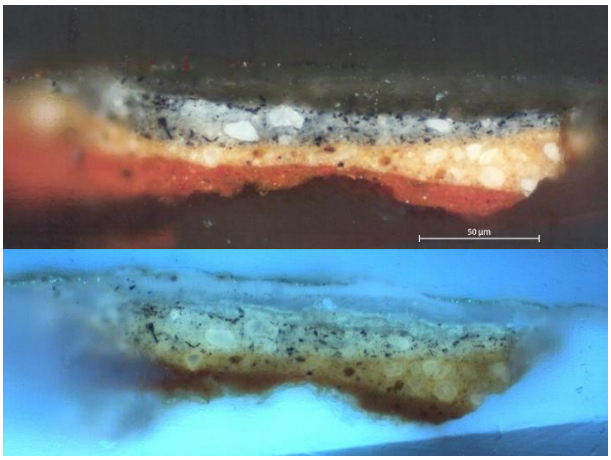
4.4 St Jerome - Presented by Meghan van der Drift

Painter unknown, no signature
Date after 1600
Place of creation unknown, assumed Netherlands
Materials: oil on canvas
Owner/Collection: Museum Catharijneconvent, Utrecht
Inventory Reference: BMH s1128
Measurements 93.5cm x 77cm x 4cm (with frame) 81cm high x 65cm wide x 1.8cm (without frame)

Recto before treatment

Verso after cleaning

Xradiograph



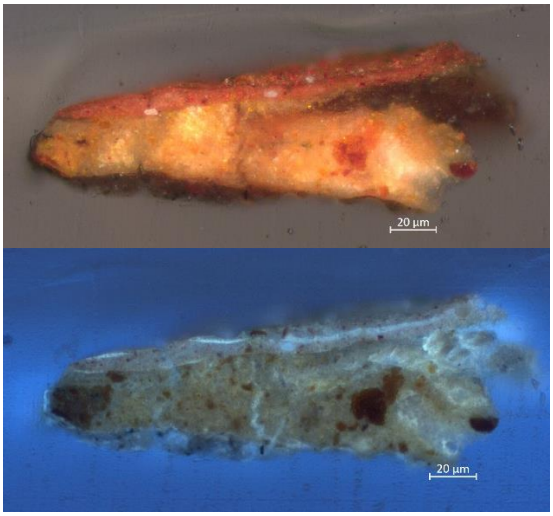
Cross sections

4.5 Christ Tied to a Column - Presented by Varin Marthinson

Painter; Jan Thomas van Kessel (uncertain)
Date: 1709
Place of creation unknown, assumed Netherlands
Materials: oil on canvas
Owner/Collection: Museum Catharijneconvent, Utrecht
Dimensions: 41,4 x 34,5 x 2,5

Recto before treatment

Verso after cleaning



Cross sections

4.6 Guy Patin (1601-1672) - Presented by Esther van Duijn

Painter: Unknown
Date: 1650--1699
Place of creation unknown, assumed Netherlands
Materials: oil on canvas
Owner/Collection: Amsterdam Museum
Dimensions: 81,2 x 64,5 x 33,3 cm

Recto before treatment

Verso after cleaning

Workshop II
Carrying out a wax-resin lining according to the Dutch method

1. Organizational details

Supervised by: Michel van de Laar
Assistants: Emilie Froment and Madeleine Vaudremer
Dates: 22 and 23 January 2025
Location: *Ateliergebouw*, Amsterdam

2. Goals of the workshop

The workshop aims to provide the participants with practical experience of wax-resin lining. This experience will grow insights on the steps required to complete a full lining and the time they take. It will also illuminate the kind of materials, tools and equipment needed to accomplish the treatment. We will also look at whether the variation in materials has repercussions on the parameters for lining (heat, quantity of adhesive, pressure…). Furthermore, the workshop aims to raise awareness about whether and how variations in the technique used may influence the condition of a painting after treatment. Phenomena that will be considered are changes in surface texture, structural properties, gloss, and color. The experience gained and the observations made during the workshop are expected to be a crucial help for the participants to better understand the condition of paintings in their future practice.

3. Teaching methods

The workshop is supervised by Michel van de Laar, paintings conservator in Amsterdam. Michel was trained to line paintings with wax-resin by the Belgium paintings conservator Georg Messens (1925-2001). He frequently implemented this technique in the past. For the workshop Michel will demonstrate a wax-resin lining and supervise the participants with the lining of eight test panels (reconstructions) according to the Dutch Method. The participants will work in duo. Each pair (eight in total) will use different lining techniques (historically informed).
Reconstructions are involved in the workshop to avoid tests on historical paintings. The latter were put aside on ethical grounds, since wax-resin impregnation is irreversible and therefore not supported by present-day conservation approaches. The use of reconstructions also presents the advantage of being able to study the effects of a few specific factors. This possibility was considered beneficial for the purpose of the workshop, which aims to provide a broad experience of wax-resin lining. To provide a complete experience of wax-resin lining, however, the demonstration by Michel will be carried out on a painting selected for the educational purpose of the workshop.
At the end there is a group session to process the outcomes of the workshop.

After treatment, the reconstructions can be cut into smaller pieces so that each participant can bring a piece of the reconstruction back to their institute and share their experience with their colleagues, students, and peers.

4. The painting

4.1 Material and technical characteristics of the painting

Text by Michel van de Laar: "The real painting involved in the masterclass is a little study by my grandfather, Arnold van de Laar ('s-Hertogenbosch 1886-1974 Vught). It depicts the interior of the stable of a little farmhouse near Hintham (in between 's-Hertogenbosch and Rosmalen). My grandfather painted this particular farmhouse many times between 1915 and 1925. In the winter with snow, in the summer with sunshine, the front and the back, close up and from a distance, the interior of the house and here of the stable. He regarded the painting of this farmhouse in the snow as his best painting and it always stayed in his studio as a trophy. Many little studies of it also were kept, stuck on the wall of his studio with push pins or kept in portfolios. My grandfather became friends with the poor and primitive farmer, Piet Dielissen, and his wife and visited them often on his bike. The house is no longer there and on this exact location now runs the A2 motorway. The study is not signed or dated. It measures 27 x 32,2 cm. It was never stretched to a stretcher. It was painted pinned in his painting box on industrial prepared painters' linen with a white ground which is locally kept exposed. It is painted smooth but locally with impasto. It has been folded and is deformed. It has never been varnished. It is dirty but I will spit clean it before we are going to line it."

4.2 Wax-resin lining of the painting

Fig. 1: The painting involved in the workshop. Condition before lining: recto (*left*), verso (*middle*) and front raking light (*right*)

Will be added	*Will be added*	*Will be added*

Fig. 2: The painting involved in the workshop. Condition after lining: recto (*left*), verso (*middle*) and front raking light (*right*)

Plan: The day before lining the painting will be varnished and applied a facing and the lining canvas will be coated with the wax-resin mixture. The lining canvas will be plain weaved linen, and the adhesive probably composed of five parts beeswax to two parts colophony.

5. The reconstructions

5.1 Material and technical characteristics of the reconstructions

The reconstructions for workshop I are composed of a plain weave linen canvas laced to a wooden stretcher (70 x 50 cm) with ropes. Along the edges, the canvas is strengthened by a fold. The canvas is sized with 10% animal glue applied while liquid with a brush. In May 2024, the stretched canvasses were primed and in June 2024 the white grounds were locally covered with a layer of raw umber containing oil-bound paint; the paint was applied either smoothly or with impastos. The ground is left on view in many areas. The reconstructions were varnished with dammar in turpentine on the 10 of January 2025 (fig. 3).

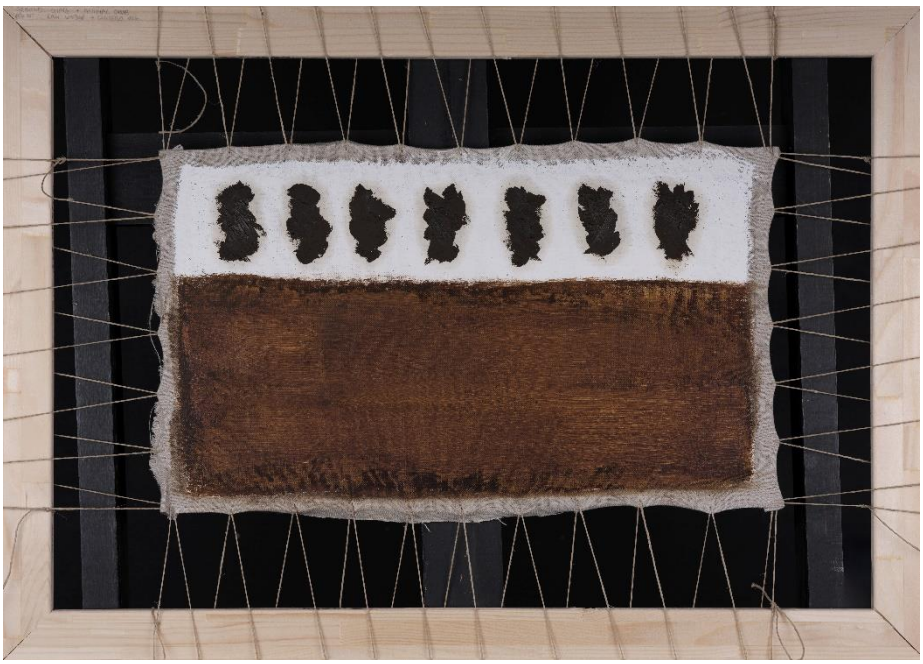


Fig. 3: Example of a reconstruction

5.2 Wax-resin lining of the reconstructions

The reconstructions are lined using eight different methods. The participants are gathered in eight pairs (1-8); each is associated with a lining method. For the pair composition, see table below:

Pair 1	Markus / Joana
Pair 2	Paula / Mariana
Pair 3	Elizabeth / Özer
Pair 4	Marie-Hélène / Ioseba

Pair 5	Julia / Madeleine / Andras
Pair 6	Matthew / Rosie
Pair 7	Meredith / Saki
Pair 8	Agnieszka / Fabiana

The variables in the methods are the type of lining canvas, the composition of the wax-resin adhesive, and the softness of the substrate during lining. The behavior of the facing materials is also looked into. Uncontrolled variables are the quantity of facing adhesive, quantity of lining adhesive, pressure from iron, contact time with iron, iron temperature. See the table below for an overview of the lining methods per reconstruction/group (marked on the stretcher).

Pair/group number	Lining canvas weave type	Lining adhesive	Facing adhesive	Substrate during lining
Pair 1	Rough	wax+resin	Rice starch	Hard
Pair 2	Rough	wax+resin	Rice starch	Soft
Pair 3	Rough	wax+resin+Venice Turpentine	Rice starch	Hard
Pair 4	Rough	wax+resin+Venice Turpentine	Rice starch	Soft
Pair 5	Fine	wax+resin	Rice starch	Hard
Pair 6	Fine	wax+resin	Rice starch	Soft
Pair 7	Fine	wax+resin+Venice Turpentine	Rice starch	Hard
Pair 8	Fine	wax+resin+Venice Turpentine	Rice starch	Soft

The agenda of the workshop is divided in two days.[1]

First day of the workshop:

- Prepare starch
- Prepare wax-resin mixtures
- The reconstructions are faced and attached on the working strainer.
- Coat the lining canvases with the appropriate wax-resin mixture

Second day of the workshop:

- Prepare tables
- Impregnate verso of lining canvas while on the reconstruction
- Line the reconstruction using hand-held hot irons.
- Remove the facing with water using sponge.
- Remove wax-resin residues with white spirit.

So that all participants can bring a sample of the reconstructions back to their institute, the reconstructions should be detached from the stretcher and cut into 8 pieces according to the schema below (fig. 4). At the end each participant will have a piece of 4 different linings. You are free to choose the ones that you want to save. The spares are for the archives of the Amsterdam

[1] A few preparatory steps were completed before the workshop takes place including the stretching of the lining canvasses, the surface cleaning of the painting, and the application of a temporary varnish

Wax-Resin Project. This will be done by the organization and spread to the participants during the masterclass.

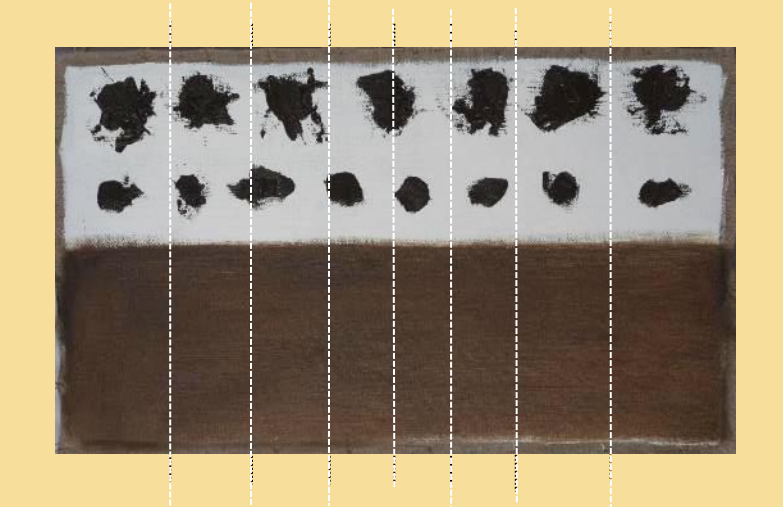


Fig. #4: the yellow area represents the lining canvas and the dotted line represents the lines of cut to divide the reconstruction in 8 parts.

6. Discussion session 1: sharing, analyzing, and reflecting

Throughout the workshop each pair will have practiced a slightly different lining technique and therefore gained a different experience in wax-resin lining. The goal of the session is to encourage the participants to exchange their experiences for the benefit of all. In this way, each participant will gain further insights into the practice of wax-resin lining (materials behavior, sequence, duration of action, level of control) and have an increased awareness of the potential (unwanted) effects of the treatment on paintings. This process is structured in three steps called *sharing, analysing, and reflecting.*

6. 1 – Sharing = 1 hour

The sharing step is composed of three rounds of 15 minute-meetings during which the participants meet in groups of four (so, two pairs). The discussion aims at sharing and comparing experiences of the different lining techniques. The first round focuses on the effect of the weave of the lining canvas, the second round on the presence of Venice Turpentine in the lining adhesive, and the third round on the hardness of the substrate during lining. See table below.

Rounds / topics	Discussion groups			
First round / weave	1 and 5	2 and 6	3 and 7	4 and 8
Second round / recipe	1 and 3	2 and 4	5 and 7	6 and 8
Third round / substrate	1 and 2	3 and 4	5 and 6	7 and 8

The content of each discussion is reported in a comparison report (1 flip over paper per conversation). The reports (12 in total) are titled according to the topic (weave/ recipe/ substrate) and the numbers of the discussion group (1 and 5/ 2 and 6/ 3 and 7/...).

Please consider the following questions and lay out the reports accordingly:

1) What are the similarities and differences in the two lining techniques that you implemented?
2) Did the difference in lining technique impact the practice? If so, how?
3) Did the difference in lining technique impact the appearance of the reconstruction? If so, how?

Once completed, each report is taped to the wall. The reports are gathered according to the topics (weave, recipe and substrate).

6. 2 – Analyzing and reflecting = 30 + 30 minutes

Study in pairs the reports and analyze the conditions under which weave/ recipe/ substrate have an impact on the appearance or condition of the reconstruction. Is the impact systematic or dependent on other factors? What other factors may come into play that we did not introduce as variables? The outcome of this process will be shared in a plenary session and summarized in one report.

6. 3 – Evaluation

In anticipation of the brainstorming session on the last day of the masterclass, take a moment to reflect on how this workshop may contribute to a better understanding of the wax-resin lined paintings in your care.

7. Update post masterclass

Personal notes

Workshop III
Color change in ground layers after wax-resin impregnation

1. Organizational details

Supervised by: Emilie Froment
Dates: 24 January 2024
Location: Ateliergebouw, Amsterdam

2. Goals of the workshop

The workshop aims to develop knowledge on color change in paintings after wax-resin lining and help conservation specialists to recognize such change in paintings. Central to this workshop is the study of optical phenomena from ground reconstructions. The material and physical characteristics of the reconstructions were chosen in order to let the trainees experience a few of the factors involved in color change due to wax-resin impregnation.

3. Teaching methods

The rationale behind of the workshop and the practicalities of it both relate to the research developed by Emilie Froment during her PhD and reported in the dissertation, "The consequences of wax-resin lining for the present appearance and conservation of 17th century paintings on canvas".[2]
During the workshop the trainees will impregnate with a wax-resin mixture two series of reconstructions consisting of different types of ground applied on canvas (Rec. II – Series I and II). For this workshop each trainee will use a similar impregnation technique, however the ground types vary with regards to pigment composition, pigment ratio, and layer thickness. The small size of the reconstructions enables the participants to take them with them to their institute after the workshop. In this way, the effects of wax-resin linings can be shared further with colleagues, students, and peers.
Reconstructions are involved in the workshop because they allow factors of influence to be studied either independently or in combination. This was considered beneficial for the educational purpose of the workshop.
The outcomes of the workshops including visual observations, practical experience, results of color measurements and their interpretation, are discussed in a group discussion session to which experts in the field are taking part of.

[2] Available online: https://dare.uva.nl/search?identifier=38785f97-9204-4673-b047-2d9433577d46

4. Material and technical characteristics of the reconstructions

Recent research has shown that ground layers can undergo various level of color change depending on layer thickness, degree of hiding power, and material composition.[3] Research also identified that the type of canvas and the type of size are also influential in this. These factors of influence dictated the material and physical characteristics of the two series of reconstructions created for the workshop.

4.1 Series I

In total sixteen different types of ground were created for reconstruction series I. In May 2024, the grounds were applied in parallel strokes on a plain weave linen canvas laced to a wooden stretcher (40 x 60 cm) with ropes and sized with 10% animal glue. The animal glue was applied by hand in gelled form.
The reconstruction series I were divided in three types, (A, B, and C) each featuring a different range of grounds which vary according to color, composition, layer thickness and application method (Figure #5). The kind of grounds in each type of reconstruction enables comparative study throughout and between types.

Type A Type B Type C

Figure #5: Examples of the three types of reconstructions in series I

Several of the ground recipes used replicate as closely as possible material and physical characteristics of preparations found in seventeenth century European paintings on canvas. Therefore, the mineral content includes chalk[4] and a few iron oxides (red ochre, yellow ochre and raw umber) used independently or in combination.[5] The binding medium is either linseed oil or 8% animal glue. Furthermore, the oil-bound grounds composed of clay minerals and quartz sand were used in order to replicate the so-called quartz grounds used by Rembrandt van Rijn from 1642 onwards, including on *The Night Watch*.[6] In addition, one ground recipe is composed of zinc white in linseed oil (paint tube). This ground aims at replicating grounds found in 19th and 20th paintings. An overview of the material characteristics of the grounds in the reconstructions is in the table below.

[3] See Appendix H for a list of references on the topic.
[4] Care has been taken to remain consistent with all used materials and brands throughout the reconstructions. However, it should be noted that the chalk used for the oil bound grounds is from a different brand (Kremer Pigmente) than the chalk used for the animal glue bound grounds (Verfmolen De Kat).
[5] For health reasons lead white was not used.
[6] See publications by Karin Groen.

Number	Composition	Application method
Series I		
Type A		
#1	9,8 g natural chalk: 0,1 g yellow ochre: 0,1 g raw umber in linseed oil	Paint film applicator 30 μm
#2	9,8 g natural chalk: 0,1 g yellow ochre: 0,1 g raw umber in linseed oil	Paint film applicator 120 μm
#3	6,6 g clay: 3,1 g quartz sand: 0,3 g raw umber in linseed oil	Brush
#4	Red ochre in animal glue	Brush
#5	9,8 g natural chalk: 0,2 g red ochre in animal glue	Brush
#6	9,8 g natural chalk: 0,2 g red ochre in linseed oil	Brush
#7	Red ochre in linseed oil	Brush
#8	Schmincke zinc white linseed oil	Brush
Type B		
#9	6,6 g clay: 3,4 g quartz sand in linseed oil	Brush
#10	Red tile in animal glue	Brush
#11	9,8 g natural chalk: 0,2 g tile red in animal glue	Brush
#12	9,8 g natural chalk: 0,2 g tile red in linseed oil	Brush
#13	Tile red in linseed oil	Brush
#14	9 g natural chalk: 0,5 g yellow ochre: 0,5 g raw umber in linseed oil	Brush
#15	9,8 g natural chalk: 0,1 g yellow ochre: 0,1 g raw umber in linseed oil	Brush
#16	Schmincke zinc white linseed oil	Brush
Type C		
#17	6,6 g clay: 3,1 g quartz sand: 1,5 g raw umber: 1,5 g yellow ocher in linseed oil	Brush
#18	Red ochre in animal glue	Brush
#19	9,8 g natural chalk: 0,2 g red ochre in animal glue	Brush
#20	9 g natural chalk: 1 g red ochre in linseed oil	Brush
#21	9 g natural chalk: 1 g tile red in linseed oil	Brush
#22	9 g natural chalk: 0,5 g yellow ochre: 0,5 g raw umber in linseed oil	Brush
#23	9,8 g natural chalk: 0,1 g yellow ochre: 0,1 g raw umber in linseed oil	Brush
#24	Schmincke zinc white linseed oil	Brush

4.1 Series II

Series II aims at replicating 20th century painting techniques with a focus on American painters in the 1950-70s (fig. 6). This reconstruction was created in 2020.

Figure #6 Reconstruction series II

The support consists of plain weave cotton canvas stapled to a wooden stretcher (40 x 50 cm) and sized with 10% animal glue applied while liquid with a brush. Three different types of white grounds were applied composed of either zinc white, titanium white, or a mixture of both pigments in linseed oil (paint tubes). Furthermore, there are two grounds in rabbit skin glue colored with either cadmium yellow or permanent red (a technique used by Mark Rothko in a few of his paintings). There is also a ground composed of cobalt blue in linseed oil (paint tube). The table below provides an overview of the material characteristics of the ground reconstructions.

Number	Composition	Application method
Series II		
#25	Titanium white in linseed oil	Brush
#26	Titanium white : zinc white (1:1) in linseed oil	Brush
#27	Zinc white in linseed oil	Brush
#28	Cadmium yellow in rabbit skin glue	Brush
#29	Permanent red in rabbit skin glue	Brush
#30	Cobalt blue in linseed oil	Brush

5. Wax-resin treatment of the reconstructions

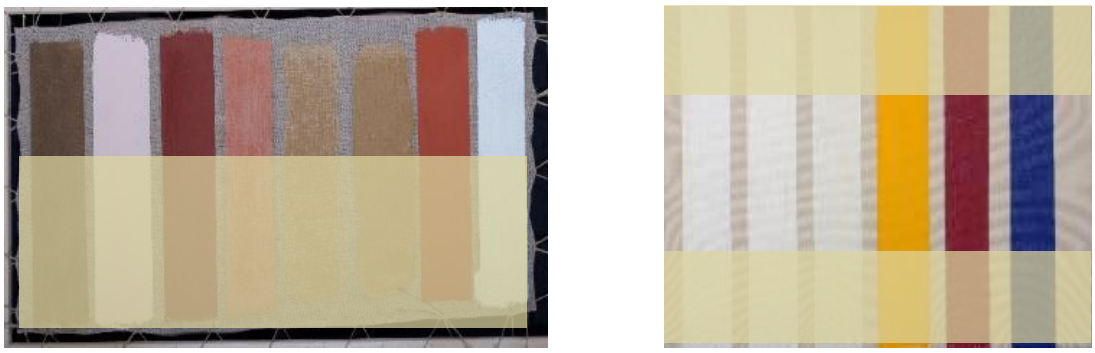
Each participant is attributed a reconstruction from series I that they will impregnate partially with a wax-resin mixture (fig. 7). The participants are divided into three groups of 5 (A, B, C) which each corresponds to a type of reconstruction. This means that participants in group A impregnate the reconstructions type A, the group B the reconstructions type B, and the group C the reconstructions type C. See below for the type of reconstruction and the names associated.

Reconstruction type	Names
A	Markus / Joana / Paula / Elizabeth / Marie-Hélène
B	Özer / Andras / Meredith / Saki / Agnieszka
C	Ioseba / Mariana / Matthew / Julia / Fabiana / Rosie

The impregnation of series II is possible for whomever is interested. When cut in the middle it provides 2 samples with the possibility for 2 separate impregnations.

The lining technique used is similar throughout the participants and series of reconstructions. The impregnation technique is as follows:

- A table offers a working spot for 2 participants.
- Cover the lining tables with absorbent paper (4 layers).
- Detach the canvas from the stretcher with scissors.
- Lay the reconstruction face down on the absorbent paper.
- Warm the wax-resin composed of wax and colophony 5:2 on the hot stove setting P600 Celsius 60.
- Apply the warm wax-resin adhesive to the reverse of the reconstruction with a brush. Mind that only half of the reconstruction should be impregnated. This is implemented in order to preserve an untreated area which provides visual reference of the condition before impregnation and allows one to assess the degree and quality of color change. Follow the instructions in figure #7.
- Melt the wax-resin using a hand-held hot iron (position "wool").
- Impregnate one color at a time, although the precision of the iron will challenge such selective treatment.
- Move the canvas regularly to avoid the wax-resin that leaks onto the paper through the bare canvas from staining the front of the paint layer.
- You may repeat the application 2 times per color area.
- Observe the effect caused at the front.



Series I Series II

Figure #7: the areas impregnated are represented in yellow

Each participant is attributed a reconstruction of the Series I. It can be brought back to the institution after being rolled with a piece of silicon Melinex.

6. Opacity charts

An important aim of the workshop is to develop knowledge regarding the influence of the degree of hiding power on the extent of ground color change after wax-resin impregnation. In this purpose, each ground recipe was applied on opacity charts at two different thicknesses, namely 50 µm and 200 µm (figs. #8 and #9).

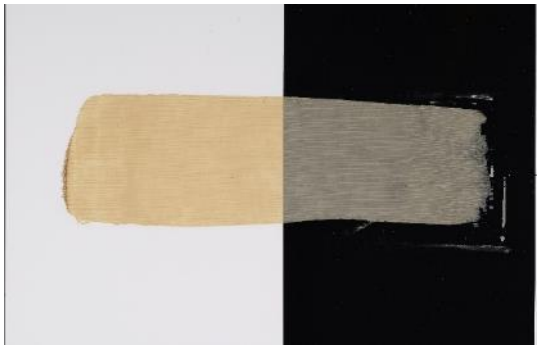


Figure #8: Ground composed of chalk, yellow ochre and raw umber applied at 50 microns

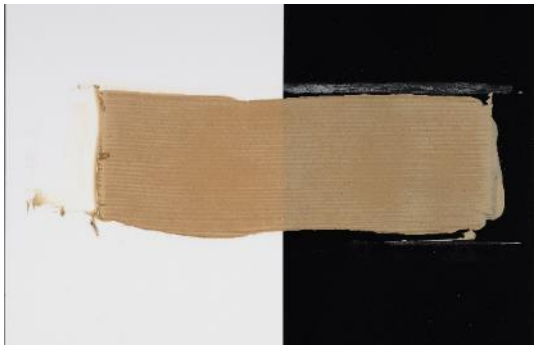


Figure #9: Ground composed of chalk, yellow ochre and raw umber applied at 200 microns

Through visual comparison and color measurements the charts will allow one to assess the degree of hiding power of each ground. Results will support the understanding of the grounds appearance after lining. The cards will be available in the studio during the workshop.

7. Color measurements

Color measurements with a Konica Minolta spectrophotometer are used to support visual assessment. Excel sheets were prepared with the color data of each ground before impregnation. The measurements after lining can be added to the table which automatically will calculate the color difference in the L*a*b* color space (SCE, UV= 0%, 10 degrees).
Please use this link: Color measurements for masterclass.xlsx

8. Discussion session 2: sharing, analyzing, and reflecting

Different color change will be observed depending on the different grounds applied in each type of reconstruction. Because there are many types of grounds, the goal of the discussion session is that each participant benefits from the variety and has more insight into the factors influencing color change in paintings as a consequence of wax-resin impregnation. The session includes three discussion rounds which encourage the sharing of experiences and a collaborative reflection on the topic.

8.1 – Sharing and analyzing = 1 hour

- First round (10 minutes): each participant individually observes and studies the condition of their own set of grounds. Consider which grounds are relevant to compare. Characterize the color change (hue, lightness, gloss) and identify factors influencing the change. We also recommend

considering the opacity charts available in the studio. Each ground is applied on this substrate which provides an indication of the degree of hiding and therefore on whether the darkened canvas is influential for the color of the ground after lining. Report your observations in writing for yourself. Color measurements can be involved.

- Second round (20 minutes): the participants meet per type of reconstruction (A, B, and C). See the table below for the group composition. The goal of the conversation is to compare findings and exchange viewpoints on the characteristics of the color change and the causes for it. Since the reconstructions are similar, the observations should have much overlap. The analysis of the effects caused by the impregnation may however differ per participant. Please record this for yourself in writing.

Discussion groups / second round	
A	Markus / Joana / Paula / Elizabeth / Marie-Hélène
B	Özer / Andras / Meredith / Saki / Agnieszka
C	Ioseba / Marianna / Matthew / Julia / Fabiana / Rosie

- Third round: the participants meet in mixed groups (5 groups of 3 participants). Each member of the group has one type of reconstruction (A, B, C). See the table below for the group composition. The goal of the conversation is to further expand the discussion. In the third round the number of ground types is significantly increased, which provides more material to understand color changes in paintings after wax-resin impregnation. The findings are summarized and reported on a flip-over paper. 20 minutes.

Discussion groups / third round	
1	Markus / Özer / Ioseba
2	Joana / Andras / Marianna /
3	Paula / Meredith / Matthew
4	Elisabeth / Saki / Julia / Fabiana
5	Marie-Hélène / Agnieszka / Rosie

8.2 – Reflection session supervised by Ysbrand Hummelen

The results of the third round are presented to Ysbrand Hummelen. He will elaborate on the participants' inputs based on the condition of the reconstructions.

Background information on Ysbrand's contribution:
A painting can be considered as 'an event of light and matter' during its making, and as a similar event in the perception and experience of the beholders during its intentional existence. Next to color wavelength as one of the effects of light and matter, the 'modes of appearances of color', (i.e., the behavior of light in the whole paint layer and surface structure, e.g., brush strokes, matteness, glossiness, transparencies and opaqueness in the layer structure) are just as important parameters in the making and perception of paintings.

In our discussion of the samples, we will consider the effects of wax-resin linings on the different 'modes of appearance of color' in paintings and try to extrapolate and relate these effects to different styles, techniques, perceptions and intentions on paintings from different epochs and artists in the practice of the participants.

'Modes of appearance of color' are categorized by several phenomenologists in terms of a.o. surface color, volume color, film color, local color, emitted color, and illuminate color. Artists use terms like transparency, opaqueness, matte-ness, gloss, etc. In terms of physics is it expressed in addition to color measurements (e.g. CIELAB) in the K/S rates of scattering (S) and absorption (K) of light from, in, and through the surface of objects and paintings.
'Modes of appearance of color' in perception studies are also related to synesthetic perception of the visual and optic effects and to the paint surface structure that affects the sense of touch as a skin.

Katz, David. *The World of Colour*. (1935) Routledge, 1999.
Katz, David, en Lester E. Krueger. *The World of Touch*. (1925) L. Erlbaum, 1989.
Schöne, Wolfgang. *Über das Licht in der Malerei*. (On Light in Painting) Gebruder Mann Verlag,1955

9. Update post masterclass

Personal notes

Workshop IV
Effects of wax-resin lining on mechanical properties of paintings

1. Organizational details

Supervised by: Cecil Krarup Andersen
Dates: 28 and 29 January 2025
Location: Ateliergebouw, Amsterdam

2. Goals of the workshop

The workshop aims to raise awareness on how wax-resin impregnation and lining changes the structural and mechanical properties of a painting. Furthermore, it aims at providing an understanding of basic mechanical and structural concepts and processes like stiffness/flexibility, adhesion and delamination through shear forces, and moisture induced shrinkage and bulging.
Consider the following questions before the workshop:

1) Are wax-resin linings strong? -how and in which cases are they strong or not so strong?
2) How can we check their strength?
3) Are wax-resin linings more prone to bulging with change in humidity or temperature? -why/why not?

3. Teaching methods

1) Brush-up lecture: Basic mechanics and the relation to wax-resin and paintings.
2) Test of samples (see below)
3) Presentation and discussions of samples and peel/shear tests and the relation to painting delamination and bulging.

4. Description of the experiment

Samples and instrumentation

In the workshop we will test canvas impregnated with wax-resin as well as primed canvas lined with wax-resin and linen canvas. At least two different canvases impregnated with different wax-resin recipes are tested. BEVA film is also used for comparison.
Participants are welcome to bring a sample of a typical wax-resin mixture and a piece of canvas that is familiar to their practice. These can be tested in the workshop.
Other materials: humidity chambers, tensile test setup, hot spatulas.

Guidelines for the testing procedure

1) Deformation due to moisture exposure
    a. On 28 January, a strip of impregnated canvas (2,5 x 20 cm) and unimpregnated reference samples in both weave directions are subjected to high moisture.
    b. On the 29 January, morning the condition of the samples is studied. The discussion focuses on assessing the implications of the results for stress and bulging in paintings.

2) Shear test.
    a. A bare and primed linen canvas (both 20 cm long) are bonded together with either a wax-resin mixture or BEVA film with an overlap of 3 cm. The samples are subsequently cut in 3 cm wide strips. The samples are tested by hand in shear and peel.

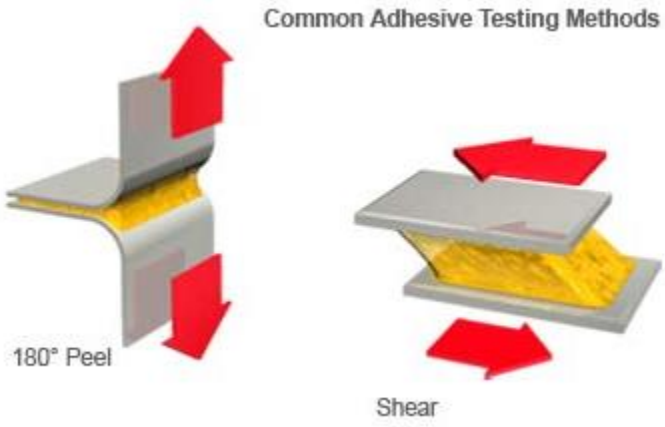


Image: http://www.adhesivetest.com/peal_test.htm

    b. The participants are divided into four groups. Each group estimates how much force it takes to pull the samples apart
    c. The samples are pulled manually from each other to estimate the degree of force (very low, low, middle, high, very high)

5. Interpretation of the results

6. Group discussion

7. Update post masterclass

Personal notes

Workshop V
Mist-lining for wax-resin lined paintings

1. Organizational details

Supervised by: Kate Seymour and Joanna Strombek
Dates: 29 and 30 January 2024
Location: Ateliergebouw, Amsterdam

2. Program

9:00 AM – 9:15 AM | Welcome & Introductions

- Welcome participants and introduce the facilitator(s).
- Activity: Brief introductions, with participants sharing their experience or interest in lining and wax-resin treatments.

9:15 AM – 9:30 AM | Workshop Overview & Objectives

- Provide an overview of the session's goals:
    - Understanding **wax-resin lining retreatment** processes.
    - Examining different examples of **retreated wax-resin lined canvases**. We will provide samples of previously lined wax-resin lined canvases for examination.
    - Analyzing the effects of retreatment on the material properties and condition of the artwork.
- Activity: Discuss the relevance of retreating wax-resin linings in conservation practices (e.g., improving adhesion, reworking deteriorated linings, or stabilizing aging canvases).

9:30 AM – 9:55 AM | Session 1: Introduction to Wax-Resin Lining and Retreatment Techniques

- **Retreating Process**: Explore the techniques used to remove excess wax-resin adhesive, including:
    - Mechanical removal
    - Solvent extraction
    - Heat Treatment
- Discuss the **effects** of these treatments on the artwork and the lining's integrity (e.g., changes in flexibility, adhesion strength, and surface appearance).
- Activity: prepare swatches of different wax-resin samples for lining experiments.

9:55 AM – 10:05 AM | Short Break

- 10-minute break to refresh.

10:05 AM – 10:35 AM | Session 2: Solvent Reactivation Tests

- **Activity (demonstration)**: Simulate the solvent reactivation of the acrylic adhesive using different solvents:
    - Prepare sandwiches boxes (we require 4 boxes with a good seal - size approx. 10 x 15 cm)
    - Prepare swatches of pre-sprayed lining canvas with acrylic adhesive x4 (we will bring the swatches)
    - Prepare solvent reactivation cloths x 4 (ethanol, isopropanol, Shellsol A, xylene) (we require 4 syringes and needles with max 3 ml capacity + kitchen clingfilm wrap. We will bring the cheesecloth for the solvent reactivation cloth)
    - Place solvent reactivation cloth in a sealed enclosed space (sandwich box) for 5 minutes.
    - Evaluate the speed of solvent activation of the adhesive.
    - Repeat as necessary for 10 mins.
- Discuss the results.

10:35 AM – 11:05 AM | Session 3: Simulation of wax-resin lining with Mist-Lining

- **Activity (demonstration)**: Simulate the Mist-Lining of previously wax-resin lined paintings:
    - We will demonstrate the lining set up and steps. Note that we will not have time to do a lining (even a mock-up). We will bring with us a previously lined wax-resin lining canvas for review.
    - Carry out a dry run showing the capacity of the low-pressure envelope. (We will bring with us material for the envelope - we will need masking tape.)
- Review the Mist-Lining process
- Review and evaluate the previously Mist-Lined mock-up.
- **Group Discussion**: Open the floor for participants to share their observations and ask questions about the different treatment methods they see.

11:05 AM – 11:35 AM | Session 4: Examining Retreated Wax-Resin Lined Canvases

- **Group Activity**: In small groups, participants will examine various retreated wax-resin lined canvases.
    - Participants will note the differences in the quality of the lining, flexibility, and adhesion after retreatment.
    - Participants may de-line the mock-ups and evaluate any residues left on the reverse of the 'original' canvas.

11:35 AM – 11:50 AM | Group Discussion

- Group discussion on the merits of Mist-Lining previously wax-resin lined canvases
- Alternatives to Mist-Lining - use of interleaf to provide additional stiffness.
- Facilitators will offer expert insights and suggestions on how to address common challenges.

11:50 AM – 12:00 PM | Wrap-Up & Next Steps

- Summarize the key takeaways: the importance of retreating wax-resin linings, methods for reactivating linings, and how to assess the condition of retreated canvases.

- Provide resources for further learning, including guides on wax-resin mixtures, retreatment techniques, and troubleshooting.

Personal notes

Appendix

Appendix A: Documentation reconstructions series I type A

Ground composition

	Number	Composition	Application
	#1	9,8 g natural chalk : 0,1 g yellow ocher : 0,1 g raw umber in linseed oil	Paint film applicator 30 µm
	#2	9,8 g natural chalk : 0,1 g yellow ocher : 0,1 g raw umber in linseed oil	Paint film applicator 120 µm
	#3	6,6 g clay : 3,1 g quartz sand : 0,3 g raw umber in linseed oil	Brush
	#4	10 g red ochre in animal glue	Brush
	#5	9,8 g natural chalk : 0,2 g red ochre in animal glue	Brush
	#6	9,8 g natural chalk : 0,2 g red ochre in linseed oil	Brush
	#7	5 g red ochre in linseed oil	Brush
	#8	Schmincke zinc white linseed oil	Brush

Photo documentation Reconstruction Series I #A1

Reconstruction #A1: before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo documentation reconstruction series I #A2

Reconstruction #A2: before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo documentation reconstruction series I #A3

Reconstruction #A3: before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo documentation reconstruction series I #A4

Reconstruction #A4: before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo documentation reconstruction series I #A5

Reconstruction #A5: before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Appendix B: Documentation reconstruction series I type B

Grounds composition

	Number	Details	Application
	#9	6,6 g clay : 3,4 g quartz sand in linseed oil	Brush
	#10	10 g red tile in animal glue	Brush
	#11	9,8 g natural chalk : 0,2 g tile red in animal glue	Brush
	#12	9,8 g natural chalk : 0,2 g tile red in linseed oil	Brush
	#13	10 g tile red in linseed oil	Brush
	#14	9 g natural chalk : 0,5 g yellow ochre : 0,5 g raw umber in linseed oil	Brush
	#15	9,8 g natural chalk : 0,1 g yellow ochre : 0,1 g raw umber in linseed oil	Brush
	#16	Schmincke zinc white linseed oil	Brush

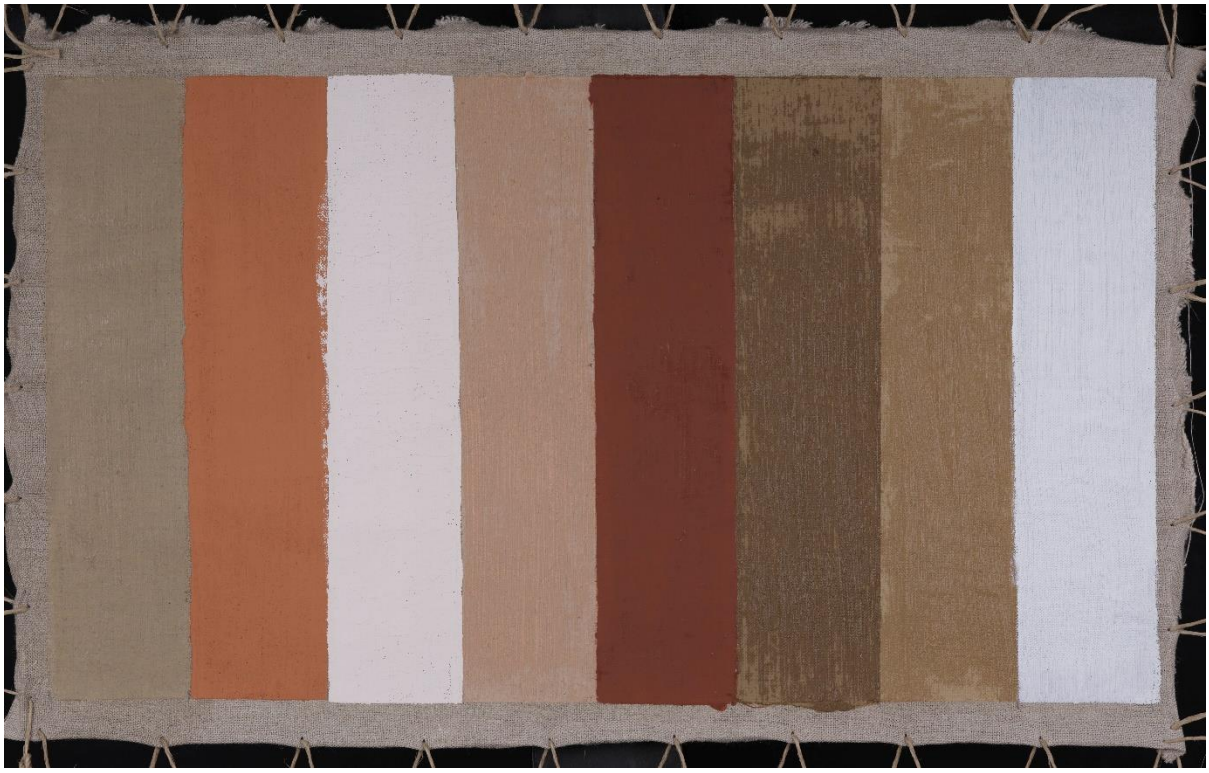
Photo documentation reconstruction series I #B1

Reconstruction #B1 before wax-resin impregnation (22 July 2024)

After lining

Notes

Photo documentation reconstruction series I #B2

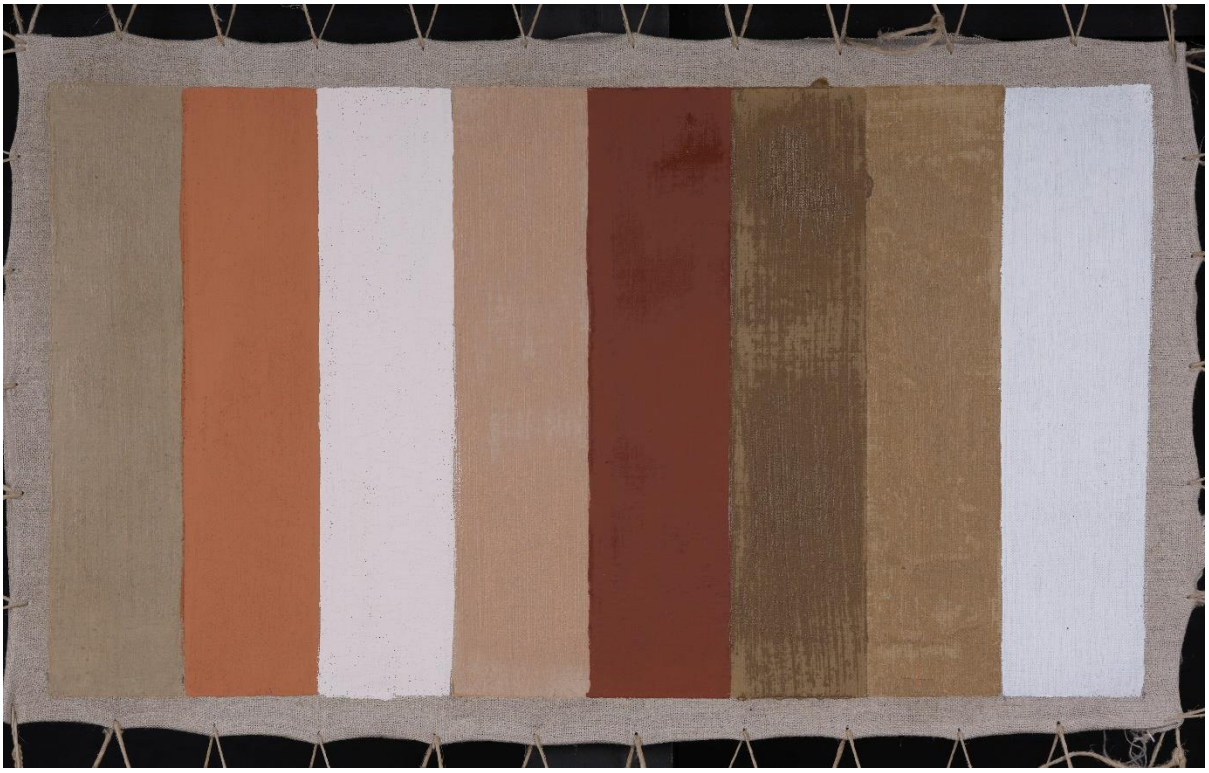


Reconstruction #B2 before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo documentation reconstruction series I #B3

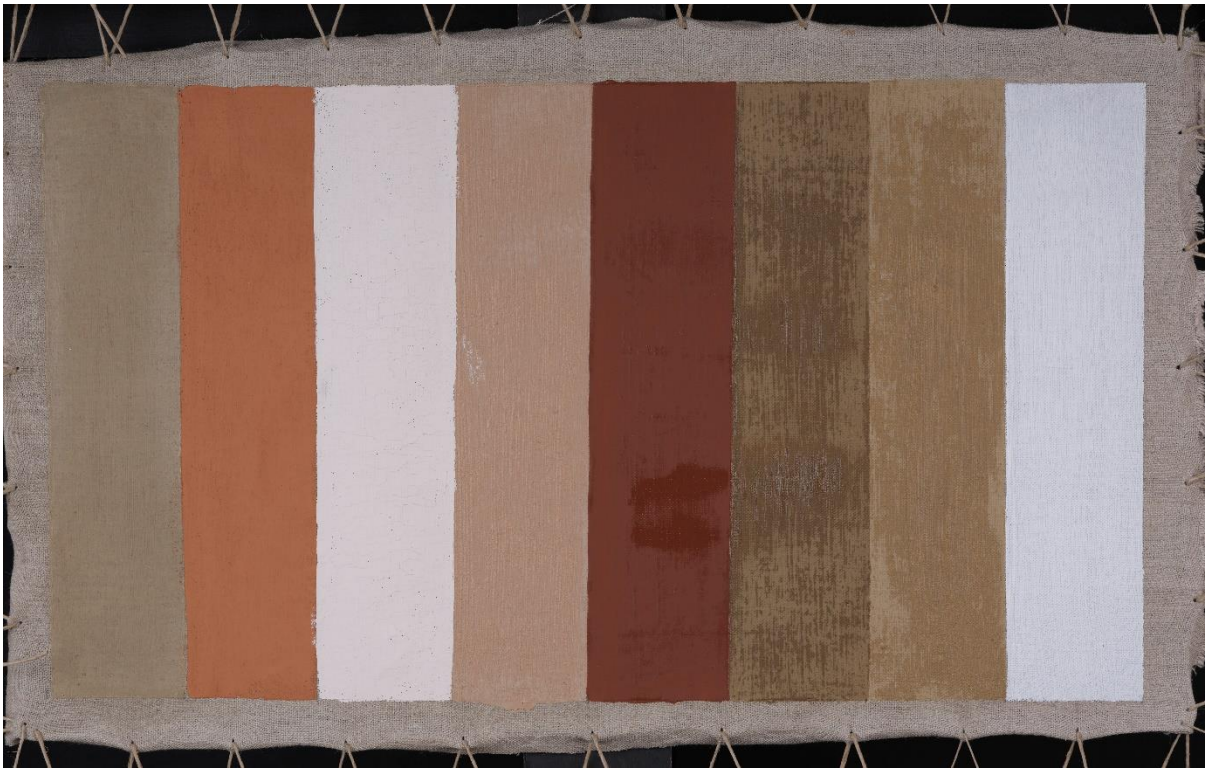


Reconstruction #B3 before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo documentation reconstruction series I #B4



Reconstruction #B4 before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo documentation reconstruction series I #B5

Reconstruction #B5 before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

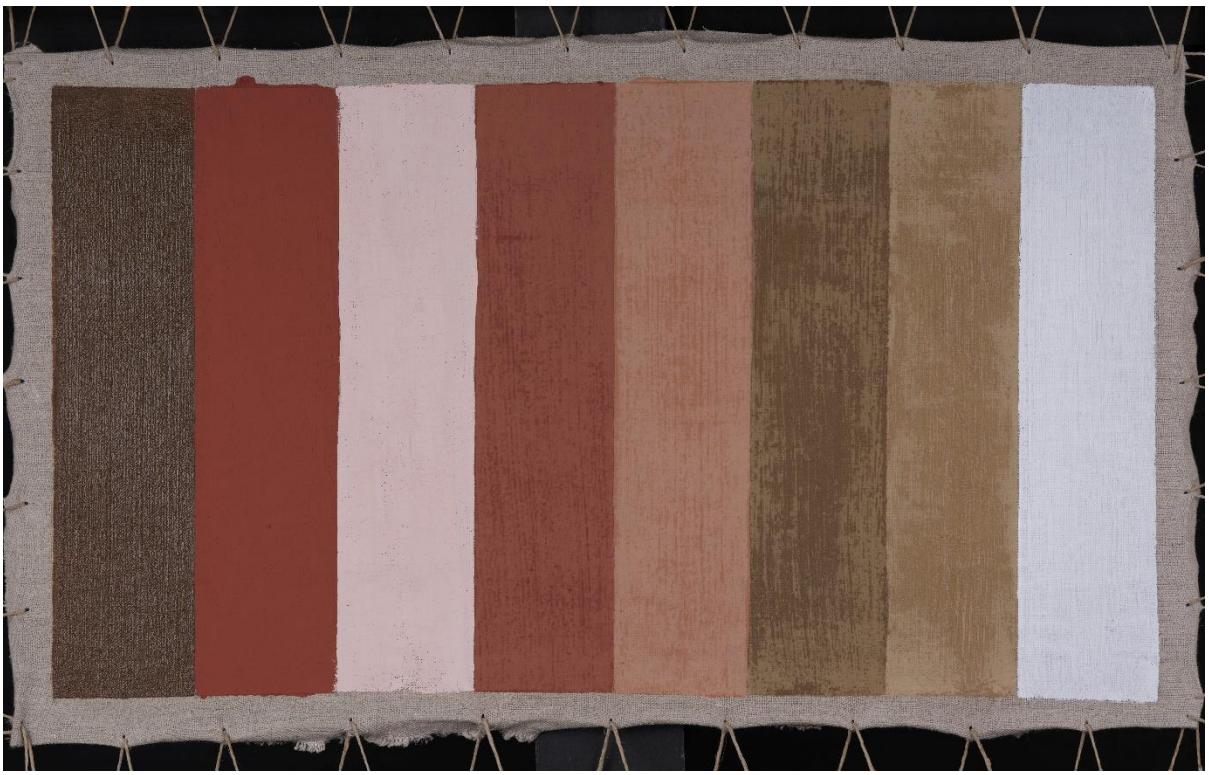
Notes

Appendix C: Documentation reconstruction series I type C

Grounds composition

	Number	Details	Application
	#17	6,6 g clay : 3,1 g quartz sand : 1,5 g raw umber : 1,5 g yellow ocher in linseed oil	Brush
	#18	10 g red ochre in animal glue	Brush
	#19	9,8 g natural chalk : 0,2 g red ochre in animal glue	Brush
	#20	9 g natural chalk : 1 g red ochre in linseed oil	Brush
	#21	9 g natural chalk : 1 g tile red in linseed oil	Brush
	#22	9 g natural chalk : 0,5 g yellow ochre : 0,5 g raw umber in linseed oil	Brush
	#23	9,8 g natural chalk : 0,1 g yellow ochre : 0,1 g raw umber in linseed oil	Brush
	#24	Schmincke zinc white linseed oil	Brush

Photo Documentation reconstruction series I #C1



Reconstruction #C1 before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo Documentation reconstruction series I #C2

Reconstruction #C2 before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

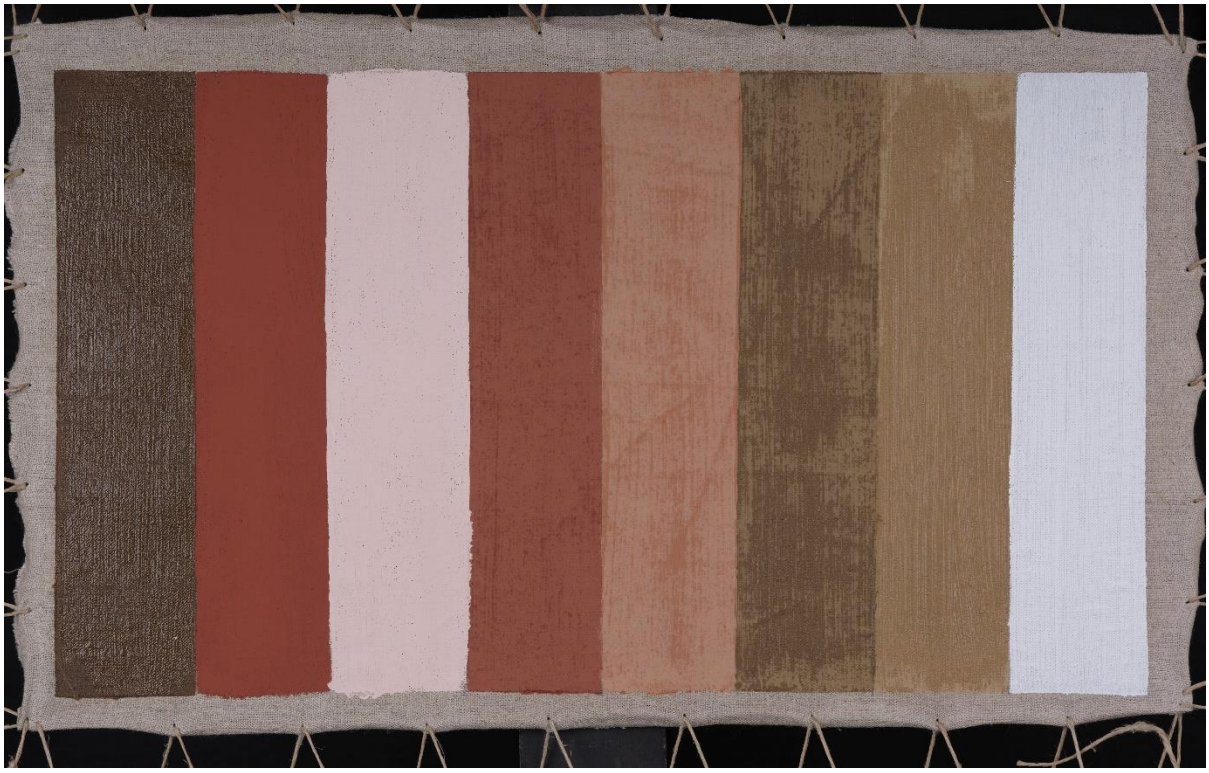
Photo Documentation reconstruction series I #C3

Reconstruction #C3 before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo Documentation reconstruction series I #C4



Reconstruction #C4 before wax-resin impregnation (22 July 2024)

After wax-resin impregnation

Notes

Photo Documentation reconstruction series I #C5

Reconstruction #C5 before wax-resin impregnation (22 July 2024)

After lining (will be added after the Masterclass)

Notes

Appendix F: List of materials and instruments for the reconstructions in workshops I and II

Type of material	Information provided by the supplier	Details of the supplier and manufacturer	Product reference
Canvas			
Linen Brussel canvas	100% linen ± 275 g/m² Plain weave Unprepared	Van Beek Art Supplies Stadhouderskade 63 1072 AD Amsterdam Netherlands Produced by Claessens canvas Molenstraat 47 8790 Waregem België	119019
Binding media			
Linseed oil	Cold pressed, may contain a small amount of mucilage.	Kremer Pigmente GmbH & Co. Hauptstrasse 41-47 88317 Aichstetten Germany	73054
Rabbit skin glue	Made from rabbit hide Form: grains.		63028
Pigments and oil paint in tube			
Natural chalk	Origin: Omey, Champagne, France Form: powder	Kremer Pigmente GmbH & Co. Hauptstrasse 41-47 88317 Aichstetten Germany Verfmolen De Kat Kalverringdijk 29 1509 BT Zaandam	58000 P.W. 18
Ball clay	05 bloem BLOEMISTENKLEI without chamotte Form: paste	Van Beek, Amsterdam Weteringschans 201 1017 XG Amsterdam Netherlands	468292

Tile red	100 year old roof tiles composed of Maas river clay. Grinded in the windmill De Kat, Zaandam.	Verfmolen de Kat Kalverringdijk 29 1509 BT Zaandam	
Quartz sand		Collection UvA studio	
Red ochre	Ochre de Roussillon	Collection UvA studio	
Zinc white	Rembrandt tube paint Artist quality Pigment: PW4 + linseed oil	Van Beek, Amsterdam Weteringschans 201 1017 XG Amsterdam Netherlands	117 Series 1
Titanium white	Rembrandt tube paint Artist quality Pigment: PW6/PW4 + linseed oil		118 Series 1
Raw umber	Oud Holland Classic Oil Colours Natural iron oxide PBr7		69 Series A
Yellow ochre	TalensVan Gogh oil colour PY42		227 Series 1
Cobalt blue	Oud Holland oil paint tube		250
Permanent red	De kat		P.R.48:4
Yellow ochre	French Ochre	Collection UvA studio	
Raw umber	Raw Umber Cyprus	Kremer Pigmente GmbH & Co. Hauptstrasse 41 – 47 88317 Aichstetten Germany	40610
Opacity charts			
Form 2A, opacity chart, Leneta Co	Form 2A is a black and white sealed opacity chart. The top is black and the bottom is white	Leneta Company, Inc. 15 Whitney Rd. Mahwah, NJ, 07430 US www.leneta.com	

	with overall dimensions of 5-1/2 x 10 in (140 x 254 mm).		
Form N9A, opacity chart, Leneta Co	Form N9A-2 is a black and white Unsealed Test Chart. The top most area is striped pattern, then black, then white with overall dimensions of 5-1/2 x 10 in (140 x 254 mm).		
Instruments			
Film applicator / draw down bar	Type: Filmograph baker; Width: sixty millimeters.	Elcometer B.V. Euclideslaan 259 3584 BV Utrecht Netherlands	3520

Appendix G: List of materials and instruments for the wax-resin adhesive

Type of material	Information provided by the supplier	Details of the supplier	Product reference
Canvas and stretcher			
- Plain weave linen - Panama weave linen	100% linen from Belgium	N&N stoffen Albert Cuypstraat 146 1073 BJ Amsterdam	
- Stretchers		Van Beek, Amsterdam Weteringschans 201 1017 XG Amsterdam Netherlands	
Binding media for the wax-resin adhesive			
- Natural beeswax		Deffner and Johan	4180100
- Colophonium		Verfmolen De Kat	
Venetian turpentine		Talens	Series 5 24280019
Materials for facing			
- Paper - methyl cellulose			
Instruments			
Tefal irons Willard irons			

Appendix H: List of references on recent research on color change in paintings after wax-resin lining

2019

Froment, Emilie. "The consequences of Wax-Resin Linings on the Present Appearance and Conservation of Seventeenth Century Netherlandish Paintings on Canvas." PhD dissertation, University of Amsterdam, 2019.
Available through: https://dare.uva.nl/search?identifier=38785f97-9204-4673-b047-2d9433577d46

2010

Watson, Meredith, Aviva Burnstock,… "Changes in the appearance of 19th century grounds on canvas upon varnishing and varnish removal." *New Insights into the Cleaning of Paintings: Proceedings from the Cleaning 2010 International Conference, Universidad Politecnica de Valencia and Museum Conservation Institute*, edited by Mecklenburg, Marion F., Charola, A. Elena, and Koestler, Robert J., 77–84. Smithsonian Contributions to Museum Conservation. Washington, DC: Smithsonian Institution.
Available through: https://repository.si.edu/handle/10088/20492

2011

Nieder, Emily, Ella Hendriks, and Aviva Burnstock. Colour Change in Sample Reconstructions of Vincent van Gogh's Grounds Due to Wax-Resin Lining. *Studies in Conservation*, 56 (2011): 94-103.
Available through: https://www.jstor.org/stable/42751903?seq=1#metadata_info_tab_contents

1994

Heydenreich, Gunnar. "Removal of a Wax-Resin Lining and Colour Changes: A Case Study." *The Conservator*, 18 (1994): 23-27.
Available through:
https://www.tandfonline.com/doi/abs/10.1080/01410096.1994.9995081?journalCode=rcon18

1985

Bomford, David, and Sarah Staniforth. "Lining and Colour Change: Further Results." *National Gallery Technical Bulletin* 9 (1985): 65-69.
Available through: https://www.nationalgallery.org.uk/research/research-resources/technical-bulletin/lining-and-colour-change-further-results

1981

Bomford, David, and Sarah Staniforth. "Wax-Resin Lining and Colour Change: An Evaluation." *National Gallery Technical Bulletin* 5 (1981): 58-65.
Available through: https://www.nationalgallery.org.uk/research/research-resources/technical-bulletin/wax-resin-lining-and-colour-change-an-evaluation

Appendix I: Quotes from paintings conservators, conservation scientists and art historians on color change in paintings after wax-resin lining

(listed in chronological order)

Harold Plenderleith and Stanley Cursiter, "The Problem of Lining Adhesives for Paintings – wax adhesives," *Technical Studies in the Field of the Fine Arts* III-2 (1934): 98-99.

> "A point to be remembered is that pigments in which, through age, the binding property of the medium has to some extent perished may appear very different in colour from the same pigment when restored to their right content. Any change in the character of the original medium may also produce a change of colour pitch, so it may be important to ensure that the new binding medium -should it permeate the paint layer - does not differ in refractive index from the original medium. A wax-resin relining mixture may produce a heavy leaden appearance unless precautions are taken to treat pigments which have become porous with some other binder, applied on the surface before relining is started."

Stanley Cursiter and A. Martijn de Wild, "Picture Relining," *Technical Studies in the Field of the Fine Arts* V-3 (1937): 167 and 170.

> "[i]f the paint layer is in an absorbent condition, it may have to be impregnated with some medium analogous to that originally used in producing the picture. This is very important and may be particularly needful in the case of pictures where, as in many modern works, portions of the ground are left exposed between the touches of paint. If the wax mixture penetrates these exposed portions of the ground, they are almost certain to go lower in tone and so alter their relation to the superimposed or adjoining touches of pigment. This question of altered values, due to change in the refractive index of the mediums or to impregnation with mediums of a character differing from those originally used, is a frequent source of distortion in the colour values of restored pictures."

Anonymous, *Manual on the Conservation of Paintings* (International Council of Museums, 1940; repr., London: Archetype Publications, 1997), 213, 217 and 218.

> "[the lining adhesive in general] should at the same time, preserve the canvases from disintegration without altering the optical properties of the ground or of the paint layer."
>
> "Another advantage of a glue adhesive is that it interferes but very little with the optical properties of most primings (reflecting power). Wax, on the other hand, would slightly reduce the reflecting power of a more or less absorbent white priming, and thus darken somewhat a transparent painting executed on such a ground. In the case of an oil painting, the wax which penetrates the paint layer or which even spreads over its surface through the crackle would reduce the depth (transparency) of the colours a little, and thus make the darker tones appear a shade lighter and duller. In an old master - a Rembrandt or a Titian, for example - this loss of transparency would alter the effect originally intended by the artist. Moreover, as mentioned above, a varnish applied to a painting in such a condition would not retain its transparency and would tend to crackle."

"These drawbacks can, however, be met by adding a little resin, as a hardening ingredient, to the wax. Rosin (colophony) is generally used for this purpose and has so far proved very useful. In inferior grades, it has the disadvantage, of being rather dark so that for bright paintings, or for pictures where the white priming plays an important part, none but the clearest quality should be used."

Christian Wolters, "The Care of Paintings: Fabric paint supports," *Museum* XII-3 (1960): 143.

"Some experts fear that this process may change the appearance of the colours in the painting because it causes an increasing transparency, which mainly affects the ground layers and which cannot be reversed. (This technique cannot of course be used for pictures painted in distemper.) Various objections have also been raised concerning the restricted air circulation, and even impermeability thus occasioned. Other experts, on the contrary, consider that wax impregnations by no means cause total impermeability and do not affect the transparency of oil colour. Apparently little use is made of impregnations with a synthetic resin base. In theory they would be excellent, but their effects, unlike those of wax, are not as yet fully known and it is feared that they might be irrevocable. Some experts have pointed out that it is not possible to remove wax completely."

Westby Percival-Prescott, "The lining Cycle: Causes of physical deterioration in oil paintings on canvas: lining from the 17th century to the present day" in *Lining Paintings: Papers from the Greenwich conference on comparative lining techniques,* ed. Caroline Villers (London: Archetype Publications, 2003), 11.

"The wax-impregnation method is in very common use in countries in the Western world. Thousands of paintings have been lined or impregnated with the use of wax-resin mixtures. Not all of the paintings treated have fare well. In some cases, the tonal drop is almost a blackening effect, where the ground or the priming has been of such a colour to become considerably darker and thus the colour values of the original painting are sometimes savagely altered.

The dangers of a change in tone of the paint caused by the infusion of wax or wax-resin have only recently been redefined. The rough rule of thumb criteria that oil paintings will take a wax-resin impregnation, while tempera or gouache paintings will not, no longer wholly serves, for some oil paintings are almost as radically changed as tempera paintings by wax-impregnation method…We have also seen that many of the so-called 'oil grounds' are (if of the type recommended by De Mayerne) of a non-homogeneous structure and these grounds too, can easily be affected by penetration of the open cavities inherent in the structure of the material.

However, the use of gypsum, chalk and fillers was not confined to the ground and priming layers, but was often a regular component in the white paint layers of the picture, forming, with the lead carbonate, a light semi-opaque paint with increased colour 'staining power' (30).

The adulteration of lead white with chalk was also common during the 17th century as it is today and chalk continues to be a regular ingredient in artists' paints. Impregnation with wax or wax-resin can alter the vehicular balance of paint layers and lower the relative refractive index in such a way as to bring perceptible changes of tone and quality to the

paint layer. Sadly, this principle which was so clear to Muntz was not recognized by later restorers in the 19th and early 20th centuries."

"(30): High opacity whites have high stain (or tinting) resistance; low opacity whites have low stain resistance. This factor was made use of by painters in the 17th century who commonly employed two whites."

Gustav Berger and H.I. Zeliger, "Wax Impregnation of Cellulose: An irreversible process," in *Lining Paintings: Papers from the Greenwich conference on comparative lining techniques,* ed. Caroline Villers (London: Archetype publications, 2003), 26.

"To date, the following effects of all waxes on the components of easel paintings have been noted:

6. Staining of canvas on application.
7. Staining of absorbent paint films and priming on application."

Robert E. Fieux, "Consolidation and Lining Adhesives Compared" in *Lining Paintings: Papers from the Greenwich conference on comparative lining techniques,* ed. Caroline Villers (London: Archetype publications, 2003), 36.

Table 1 Comparison table for criteria.

Criteria	Wax-resin	Beva 371	PVA	Aqueous glue
Color staining	Yes	No	No	Not as demonstrated, but might

George Messens, "Hand Lining with Wax-Resin Using an Iron," in *Lining Paintings: Papers from the Greenwich conference on comparative lining techniques,* ed. Caroline Villers (London: Archetype publications, 2003), 70.

"Before describing this method of lining paintings, I would like to say that it is a pity in all cases to have to line, for even if the treatment is carried out well with precision and care, a slight change is always noticeable."

Gustav Berger and H.I. Zeliger, "Detrimental and Irreversible Effect of Wax Impregnation on Easel Painting," in *Preprints Meeting ICOM-Committee for Conservation 4th triennial Meeting Venice (*Paris: ICOM, 1975), 75/11/2-1- 15;

"After lining it was no longer the old painting because all its colour values were insidiously changed. Recent research has shown wax impregnation of paintings to be irreversible. Six researchers in Europe and United States have independently of each other provided objective scientific proof that 1. Wax stains and discolours many paint films and grounds, 2. Many wax-resin mixtures are prone to discoloration."

Ségolène Bergeon, *Science et patience ou la restauration des peintures* (Paris: Réunion des Musées Nationaux, 1990), 46, 57 and 58.

"On reproche aussi à cette methode d'introduire un matériau à base de cire qui, emplissant tous les vides, rend un peu ivoire les preparations blanches poreuses, assombrit les

preparation colorées si elles sont poreuses, et serait difficilement éliminé ultérieurement ce qui rendrait le procédé non reversible."

"D'autre part seules les preparations poreuses, claires ou non, sont transformées, mais les preparations non poreuses, meme blanches ne sont pas assombries, ce qui enlève aux détracteurs de la methode une grande partie de leurs arguments."

"La couche colorée composant les chairs, les vêtements, les feuillages et le ciel était assez couvrante pour le pas craindre dans le cas de la cire résine l'éventuel léger assombrissement de la preparation (faible car affectant surtout la couche profonde, mais peu la seconde preparation ne provoquât un assombrissement de la composition."

David Bomford, "The conservator as narrator: changed perspectives in the conservation of paintings," in *Personal viewpoints: thoughts about paintings conservation*, ed. Mark Leonard (Los Angeles: Getty Conservation Institute, 2003), 4 and 5.

"The Nineteenth-century painting in question is Camille Pissaro's *Fox Hill*…I consulted with colleagues and concluded that the painting was structurally weak: I wax-lined the painting on a vacuum hot table and remounted it on its original stretcher. This was a treatment that was completely in line with normal practice in the mid-1970s. It was routine operation that took just a few hours to carry out. We were, of course, aware of the possible drawbacks of wax lining – darkening of exposed areas of priming and unwanted texture changes – but *Fox Hill* appeared unaffected by its treatment."

Appendix J: Color measurements ground reconstructions on canvas

Ground #1: 9,8 g chalk + 0,1 g yellow ochre + 0,1 g raw umber + linseed oil 30 microns

		L*	a*	b*	DeltaE
Before	Average 1	86,78	5,8	27, 7	
After verso only	Average 2				
	(2-1)				
Before	Average 1	86,78	5,8	27, 7	
After recto-verso	Average 3				
	(3-1)				

Ground #2: 9,8 g chalk + 0,1 g yellow ochre + 0,1 g raw umber + linseed oil 120 microns

		L*	a*	b*	DeltaE
Before	Average 1	74,0	10,2	33,9	
After verso only	Average 2				
	(2-1)				
Before	Average 1	74,0	10,2	33,9	
After recto-verso	Average 3				
	(3-1)				

Ground #3: 6,6 g clay + 3,1 g quartz sand + 0,3 g raw umber + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	60,45	7,29	20,25	
After verso only	Average 2				
	(2-1)				
Before	Average 1	60,45	7,29	20,25	
After recto-verso	Average 3				
	(3-1)				

Ground #4: 10 g red ochre + animal glue

		L*	a*	b*	DeltaE
Before	Average 1	56,96	33,55	30,14	
After verso only	Average 2				
	(2-1)				
Before	Average 1	56,96	33,55	30,14	
After recto-verso	Average 3				
	(3-1)				

Ground #5: 9,8 g chalk + 0,2 g red ochre + animal glue

		L*	a*	b*	DeltaE
Before	Average 1	83,59	9,09	8,74	
After verso only	Average 2				
	(2-1)				
Before	Average 1	83,59	9,09	8,74	
After recto-verso	Average 3				
	(3-1)				

Ground #6: 9,8 g chalk + 0,2 g red ochre + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	58,25	18,20	20,32	
After verso only	Average 2				
	(2-1)				
Before	Average 1	58,25	18,20	20,32	
After recto-verso	Average 3				
	(3-1)				

Ground #7: 5 g red ochre + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	36,57	22,2	18,36	
After verso only	Average 2				
	(2-1)				
Before	Average 1	36,57	22,2	18,36	
After recto-verso	Average 3				
	(3-1)				

Ground #8: Zinc white + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	91,75	-1,41	0,67	
After verso only	Average 2				
	(2-1)				
Before	Average 1	91,75	-1,41	0,67	
After recto-verso	Average 3				
	(3-1)				

Ground #9: 6,6 g clay + 3,4 g quartz sand + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	58,35	3,72	19,74	
After verso only	Average 2				
	(2-1)				
Before	Average 1	58,35	3,72	19,74	
After recto-verso	Average 3				
	(3-1)				

Ground #10: 10 g tile red + animal glue

		L*	a*	b*	DeltaE
Before	Average 1	55,66	25,47	34,36	
After verso only	Average 2				
	(2-1)				
Before	Average 1	55,66	25,47	34,36	
After recto-verso	Average 3				
	(3-1)				

Ground #11: 9,8 g chalk + 0,2 g tile red + animal glue

		L*	a*	b*	DeltaE
Before	Average 1	90,84	3,26	6,64	
After verso only	Average 2				
	(2-1)				
Before	Average 1	90,84	3,26	6,64	
After recto-verso	Average 3				
	(3-1)				

Ground #12: 9.8 g chalk + 0.2 g tile red + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	64,37	11,20	22,84	
After verso only	Average 2				
	(2-1)				
Before	Average 1	64,37	11,20	22,84	
After recto-verso	Average 3				
	(3-1)				

Ground #13: 10 g tile red + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	40,45	24,82	27,68	
After verso only	Average 2				
	(2-1)				
Before	Average 1	40,45	24,82	27,68	
After recto-verso	Average 3				
	(3-1)				

Ground #14: 9 g chalk + 0,5 g yellow ochre + 0,5 g raw umber + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	48,87	8,05	23,38	
After verso only	Average 2				
	(2-1)				
Before	Average 1	48,87	8,05	23,38	
After recto-verso	Average 3				
	(3-1)				

Ground #15: 9,8 g chalk + 0,1 g yellow ochre + 0,1 g raw umber + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	58,79	7,76	25,92	
After verso only	Average 2				
	(2-1)				
Before	Average 1	58,79	7,76	25,92	
After recto-verso	Average 3				
	(3-1)				

Ground #16: Zinc white + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	91,75	-1,41	0,67	
After verso only	Average 2				
	(2-1)				
Before	Average 1	91,75	-1,41	0,67	
After recto-verso	Average 3				
	(3-1)				

Ground #17: 6,6 g clay : 3,1 g quartz sand:1,5 g raw umber+1,5 yellow ochre + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	36,93	8,93	20,81	
After verso only	Average 2				
	(2-1)				
Before	Average 1	36,93	8,93	20,81	
After recto-verso	Average 3				
	3-1)				

Ground #18: 10 g red ochre + animal glue

		L*	a*	b*	DeltaE
Before	Average 1	**56,96**	**33,55**	**30,14**	
After verso only	Average 2				
	(2-1)				
Before	Average 1	**56,96**	**33,55**	**30,14**	
After recto-verso	Average 3				
	(3-1)				

Ground #19: 9,8 g chalk + 0,2 g red ochre + animal glue

		L*	a*	b*	DeltaE
Before	Average 1	83,59	9,09	8,74	
After verso only	Average 2				
	(2-1)				
Before	Average 1	83,59	9,09	8,74	
After recto-verso	Average 3				
	(3-1)				

Ground #20: 9,0 g chalk + 1,0 g red ochre + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	48,37	23,43	23,28	
After verso only	Average 2				
	(2-1)				
Before	Average 1	48,37	23,43	23,28	
After recto-verso	Average 3				
	(3-1)				

Ground #21: 9,0 g chalk + 1,0 g tile red + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	61,99	15,29	21,71	
After vers only	Average 2				
	(2-1)				
Before	Average 1	61,99	15,29	21,71	
After recto-verso	Average 3				
	(3-1)				

Ground #22: 9,0 g chalk + 0,5 g yellow ochre + 0,5 g raw umber + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	57,45	6,88	24,14	
After vers only	Average 2				
	(2-1)				
Before	Average 1	57,45	6,88	24,14	
After recto-verso	Average 3				
	(3-1)				

Ground #23: 9,8 g chalk + 0,1 g yellow ochre + 0,1 g raw umber + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	64,54	6,68	23,19	
After verso only	Average 2				
	(2-1)				
Before	Average 1	64,54	6,68	23,19	
After recto-verso	Average 3				
	(3-1)				

Ground #24: Zinc white + linseed oil

		L*	a*	b*	DeltaE
Before	Average 1	91,75	-1,41	0,67	
After verso only	Average 2				
	(2-1)				
Before	Average 1	91,75	-1,41	0,67	
After recto-verso	Average 3				
	(3-1)				

Cotton duck reconstructions:

Ground #25: Titanium white + linseed oil (brush)

		L*	a*	b*	DeltaE
Before	Average 1	96.12	-0.49	5.47	
After verso only	Average 2				
	(2-1)				
Before	Average 1	96.12	-0.49	5.47	
After recto-verso	Average 3				
	(3-1)				

Ground #26: 50 g titanium white + 50 g zinc white + linseed oil (brush)

		L*	a*	b*	DeltaE
Before	Average 1	95.66	-0.14	6.94	
After verso only	Average 2				
	(2-1)				
Before	Average 1	95.66	-0.14	6.94	
After recto-verso	Average 3				
	(3-1)				

Ground #27: Zinc white + linseed oil (brush)

		L*	a*	b*	DeltaE
Before	Average 1	94.60	-0.64	8.99	
After verso only	Average 2				
	(2-1)				
Before	Average 1	94.60	-0.64	8.99	
After recto-verso	Average 3				
	(3-1)				

Ground #28: Cadmium yellow + rabbit skin glue (brush)

		L*	a*	b*	DeltaE
Before	Average 1	81.28	15.67	98.79	
After verso only	Average 2				
	(2-1)				
Before	Average 1	81.28	15.67	98.79	
After recto-verso	Average 3				
	(3-1)				

Ground #29: Permanent red + rabbit skin glue (brush)

		L*	a*	b*	DeltaE
Before	Average 1	36.25	38.86	19.54	
After verso only	Average 2				
	(2-1)				
Before	Average 1	36.25	38.86	19.54	
After recto-verso	Average 3				
	(3-1)				

Ground #30: Cobalt blue + linseed oil (brush)

		L*	a*	b*	DeltaE
Before	Average 1	32.26	7.55	-38.59	
After verso only	Average 2				
	(2-1)				
Before	Average 1	32.26	7.55	-38.59	
After recto-verso	Average 3				
	(3-1)				

Ground #31: Linen (SCE)

		L*	a*	b*	DeltaE
Before	Average 1	60.45	2.89	15.42	
After verso only	Average 2				
	(2-1)				
Before	Average 1	60.45	2.89	15.42	
After recto-verso	Average 3				
	(3-1)				

Ground #32: Cotton duck (SCE)

		L*	a*	b*	DeltaE
Before	Average 1	86.95	1.43	11.73	
After verso only	Average 2				
	(2-1)				
Before	Average 1	86.95	1.43	11.73	
After recto-verso	Average 3				
	(3-1)				