

**S.S. & WEHRMACHT
CAMOUFLAGE.
U.S. Richardson Report.
20 July 1945**

In collaboration with Dr. Borsarello.



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Introduction

By January 1945 the German Army was in retreat on all fronts. Nonetheless the German authorities were convinced of victory still, even in the field of camouflaged uniforms. Up to 1944 many patterns had been tested and most of them worn in every part of Europe. Many pictures show splinter, tan water, burred edges, oak leaves, plane trees, palms and strokes, pink peas pattern etc.

Although many of the camouflage patterns were very successful the German authorities were seeking to produce a standardised pattern of camouflage for issue to all SS and Wehrmacht units in January 1945.

This new pattern is quite revolutionary - red and pink spots amongst large black spots - very curious indeed. Indeed most historians nowadays would say it would be inconceivable to imagine Waffen SS elite troops in such a clown suit. But why these colours ? Why the Circus Clown effect ? The general opinion is that there are really two reasons for using these colours :-

1. In built up areas, or destroyed areas, the broken white, pink and pale green had a very good camouflage effect.

2. (and most important) By 1944 infra red devices were in use which could detect even a camouflaged suit at night. The Germans were well aware of this and prepared a special textile material with this camouflage.

In fact the United States Army did not introduce suits capable of confusing infra red devices until 1960 in Vietnam.

Many European armies today have suits which incorporate 4% carbon in the fibres including the French, German and Danish forces. Studies began in 1972 in France by Texunion fabrics, and by Marquardt and Schultz in Germany on the Texunion material and a camouflaged suit of this material is in service in the Danish Army and a few in the German Bundesheer, but none currently in France.

It is interesting to note that the famous 1945 new camouflage for the German Army (known as the Leibermeister pattern) was actually tested by the Belgian Army in 1955 (ABL KH 1955 (8) LP 1710 30/11/54) but was not accepted into service. The only country to actually adopt a very similar pattern to the famous Leibermeister were the Swiss whose army today wear a camouflage suit in which it is possible to see the same pattern.

Dr J.F. Borsarello.

**Camouflage Fabrics
both Plain and Printed for Military Use
by the German SS and German Army**

**Reported by
Francis S. Richardson, QMC Consultant**

20 July 1945

Development Work: The German Army has considered camouflage of major importance for a long time and considerable work was conducted for a good many years. In 1932 a pattern was adopted by the army for general use. This pattern was used as the standard but certain modifications were made from time to time. As first conceived the printed design had sharp, distinct lines between colours. Later this was altered so the lines were less distinct and the edges of each colour were irregular and tended to shade off. Still later and during the course of the war, this pattern was again modified so as to produce an even more blurred effect or blending from one colour to another. Some changes in colour combinations were also introduced.

When the SS came into being they also were interested in camouflage fabrics and decided to adopt a pattern of their own. The story goes, that they engaged well known artists who were experts in colour and had them work on the problem. Many designs were submitted and studied. Certain ones were put on cloth to determine their effectiveness. Finally one was selected and adopted by the SS. This was the work of a Professor Schick who in working out his pattern had made a study of the effect of sunlight through trees both in the summer when they were in full leaf and in the autumn when all vegetation was dried and brown. In this manner he achieved his colour combinations and some of the fabrics produced had the green combination on one side and the brown one on the other. This pattern of the SS was also modified slightly during the war.

Towards the end of the war further work was conducted in regard to pattern and colour and an entirely new one was produced. This was also the work of Professor Schick in conjunction with SS Hauptsturmführers Krug, Lechler and Fisher. Their headquarters were at Bekleidungswerk der Waffen SS 33 Karlstrasse 10, Munich. This new pattern was known as Leibermuster and was to be used especially for tentage and jackets. Furthermore, it was adopted by the army, thus simplifying the general picture in that there would be only the one pattern for both forces. Information on this new pattern was supplied to the printers bearing the date of 5th January 1945.

These various changes, by both forces, were all attempts to obtain the best camouflage effect with a printed cloth. The army changes in design, softening the lines between colours, was not considered of much significance as at a comparatively short distance the colours would blend anyway. In fact it was this blending effect or appearance of one colour at a distance that led the SS to adopt the latest pattern with its sharp distinct colours, including black. It is questionable how much of this new pattern actually reached the field. It was developed late, transportation difficulties slowed the distribution to manufacturers and the army and printers have stocks on hand which they were unable to move. Many of their soldiers returning home are seen with items of the older patterns but none have been noted with the new one. No information concerning its particular effectiveness has been obtained to date.

In all cases where a printed pattern was used, with the exception of the nylon parachute, particular attention was paid to the photographic properties of the dyestuffs, especially when photographed through infra-red filters. The I.G. Farben evaluated their entire line of vat colours in this regard and the best possible combination was chosen. For a long while there was a weakness in the combination of colour in that the green was most unsatisfactory. They eventually found that a colour known as Hydron Olive GX, which is of the vat class, but containing some sulphur, was infra-red resistant and its use greatly improved their prints in this regard.

The importance attached to camouflage in the mind of the German military is further illustrated by the fact that they seriously considered printing their regular woollen uniform fabric. This idea was a late development and did not progress beyond the experimental stage. Dyeing and printing formulae were worked out and a few metres of cloth printed. To have carried out such a programme would have been a very difficult task, as the dyeing and printing problem would have been a major one. The main deterrent, however, was the fact that they had large stocks, or fairly so, of uniforms on hand and did not have sufficient wool to start a complete new reclothing programme.

The length of the Russian campaign presented problems in camouflage against the snow, for which there had been no apparent large scale preparation. As an example, cloth for field jackets that had been dyed field grey with Indanthrene dyes was coated white on one side, so that the garment could be reversed when necessary. Another instance was a Buna coated fabric which was tan in colour and about two yards of which was supplied to each man as part of his gas protective equipment; it was also given a coating of white on one side. This was a sizeable item, apparently, as one mill alone had to back coat 600,000 of these. Quite a few plain dyed items entered their camouflage picture. The grey field jacket cloth mentioned above, a fabric coloured tan on one side and left white on the other, netting made from paper twine, which was either all white or white on one side and tan on the other, also pigment dyed spun glass netting for gun camouflage.

All of the fabrics for tent and personnel use were given a water repellent treatment. In most cases the repellent material used was one of several brands of "Persistol" manufactured by I.G. Farben.

The water repellent quality of German military fabrics received a great deal of attention and study. It was evident that there were two methods:

1. Waterproofed, so the fibres do not absorb any moisture.
2. Water repellent with some degree of absorbency.

The first was considered wrong as it prevents the swelling of the fibres and water easily penetrates the fabric.

The second was considered the best way to deal with the problem as it caused the fabrics to shed much of the water ('purl off' is their way of expressing it) while at the same time the fibres could swell as the cloth became wet, and thus prevent or greatly reduce penetration. To this end I.G. worked out the Persistols. There are several of them and their chemical composition will be dealt with in another report, covering the manufacturing of certain textile auxiliary products. It must be noted that a great variety of fabrics were used for the same purpose. A wide latitude in construction, weight and fibre content was permitted due to the lack of materials. Weavers receiving yarns for specific fabrics also received new specifications with each new lot of yarn and constructions were altered as the situation dictated. This explains the variety of fibre content, yarn sizes and constructions found, for example, in the shelter half.

All Zellwolle (Spun Rayon) fabrics have been used for various items including shelter halves. Samples of this item were obtained both in the grey and finished state. Tests will be made on it here and samples forwarded to Washington.

Details for Producing Various Camouflage Items

The following are descriptions of processing methods supplied to dyeing, printing and finishing mills. They are a combination of methods worked out in certain plants and by the experimental application Laboratory of I.G. Farben at Hoechst, also actual mill procedures.



Combination Shelter Half and Ponjo

Fabric: Mixed fabric of spun rayon and cotton 33/67

Width, raw: 145cm

Width, finished: 133 ± 2 cm

Weight of the raw material, length 100m,

width 145cm: about 40.4kg

Pre-Treatment

The closely woven fabric is nearly always treated at full width, because creases and breaking cause unremovable roughening of the fabric. Consequently, dye-jigs, a full width washing machine, drying cylinders, printing machine and ager must be adjusted to a width of cloth of 140-150cm, i.e. a working width of 160cm.

At first the fabric is desized on the dye-jig.

DESIZING LIQUOR FOR 100kg OF FABRIC:**300 litres of water of 45°C - 70°C****200-400 grams of Biolase N18 powder or C18 liquid****75-150 grams of Nekal BX extra**

The fabric is passed several times through the liquor and the batch of fabric is then wrapped in cloths in order to prevent the drying of the edges. For the purpose of desizing the fabric is allowed to stand for some hours or overnight.

DESIZING WITH VIVAL E EXTRA FOR 100kg OF FABRIC:**300-350 litres of water of 45°C - 50°C****0.8-1kg Vival E Extra****75-150 grams of Nekal BX extra**

The Vival is stirred into five times its weight of cold water and diluted with hot water until solution takes place. When working with Vival the temperature must by no means exceed 55°C. For the rest, the working process is the same as described above.

Boiling:

Recently a separate desizing is often dispensed with and the raw fabric is directly boiled on the jig or on the full width washing machine with

0.5-1 gram	Igepon or Igepal	)	
2 grams	calcined sodium carbonate or caustic soda	)	
	solution of 32½% (38°Bé)	)	per litre
1-1.5 grams	Nekal BX extra	)	

After boiling the material is rinsed hot and cold. Formerly the fabric was still further cleaned in a weak sodium Hypochlorite bath or with hydrogen peroxide, acidified and rinsed. Finally, the goods are dried on the drying cylinder, brushed and stentered.

Printing:

Example for the arrangement of the printing rollers and engravings is as follows:

i	roller for rain pattern	22 hatchings, 2mm raffle
ii	padding roller	13 hatchings
iii	water roller	
iv	green roller	screen No. 30 (Lines)
v	brown roller	screen No. 30 (Lines)

Often a weakly engraved netting roller is printed first with thickened Nekal, then the padding roller and finally the objects. If no 6-coloured printing machine is available, the printing takes place in several operations, first the object are pre-printed and dried. At the second passage through the printing machine the first printing is padded over with the blotch roller. Very uniform blotches are obtained by applying the printing colour by means of a doctor with a simple coating appliance. During the operation the blotch can first be coated and then be overprinted or the dried first print is coated.

Printing pastes and finishing of printing:

For the printing the Indanthren dyestuffs are principally used according to the potash-Rongalit process. In case the printed goods cannot be steamed on the same day, the anthrasol dyestuffs prepared according to the nitrite process are sometimes preferred, the undeveloped printings obtained by means of those dyestuffs may be stored for an almost unlimited time if they are protected against light and acid vapours.

INDANTHREN PRINTING PASTES PER KILOGRAM:

Yellowish-brown: (*padding roller*)

35 grams	Indanthren Printing Brown TMZ Suprafix paste
20 grams	Indanthren Yellow G double paste fine
4 grams	Indanthren Olive Green B powder fine

Green:

100 grams	Indanthren Brilliant Green 4G paste fine conc.
or 50 grams	Indanthren Brilliant Green 4G paste fine conc.
40 grams	Indanthren Brilliant Green B paste fine conc. for printing
60 grams	Indanthren Yellow G double paste fine

Brown:

75 grams	Indanthren Printing Brown TMZ Suprafix paste
80 grams	Indanthren Golden Orange 3G paste
5 grams	Indanthren Brilliant Green B paste fine conc. for printing
or 160 grams	Indanthren Black Brown R paste for printing
20 grams	Indanthren Golden Yellow RK Suprafix double paste

Olive: (*padding roller*)

12 grams	Indanthren Olive Green B powder fine
50 grams	Indanthren Printing Brown TMZ Suprafix paste
or 50 grams	Indanthren Olive R double paste
2.5 grams	Indanthren Brilliant Green 4G paste fine conc.

PRINTING PASTE MIXTURE:

60-180 grams	Indanthren dyestuff paste
390-120 grams	water or thickening agent
550-700 grams	stock liquor

1 kg

STOCK LIQUOR:

Stir

15 grams	potato starch and
15 grams	cold water, dilute with
200 grams	cold water and straw in
20 grams	Colloresin KB or Collapret dry, boil shortly and stir until cold, add
120 grams	potash dissolved in
130 grams	water. Then stir in
100 grams	Glycinal HG and
100 grams	Rongalit C

700grams

The thickening may also be boiled with the potash. Glycinal HD and Rongalite C are added only to the cold thickening mixture. Starches other than potato starch may be used. Good thickeners can be obtained by substituting British Gum or Okagum for the potato-starch Cellapret thickener. If the engraving is very shallow and the dyestuff content of the printing pastes is rather high, the quantity of the Rongalit in the stock liquor must be increased to about 120-150 grams.

Consumption of printing paste for 100 square metres of fabric printed on both sides, depending on the depth of the engraving is about 20-24kg.

The printed fabric is dried in the dry box at approximately 60°C and air-cooled before batching or rolling up. The pieces printed on both sides are steamed as soon as possible for 5-7 minutes in a rapid agar and again cooled. The developing is done on the full width washing machine with acetic acid and potassium persulfate or hydrogen peroxide, then the fabric is rinsed aftertreated with Igepon or Igepal at the boil, rinsed and dried. A thorough washing is necessary to ensure good fastness to crocking.

Example:

	per litre
1st and 2nd trough:	3cc hydrogen peroxide of 30%
	3-5cc acetic acid 30% (6°Be)
	temperature: 5°-60°C
3rd trough:	Hot water
4th and 5th trough:	1 gram Igepon T powder highly concentrated
	2-3 grams calcined sodium carbonate

ANTHRASON PRINTING PASTES:

Yellowish-brown: (padding roller)

12 grams	Anthrasol Golden Yellow IRK
18 grams	Anthrasol Brown IBR
280 grams	hot water
120 grams	dissolving salt CN
500 grams	thickening agent, for instance potato-starch Colloresin KB-Solvitox BG
60 grams	sodium nitrite 1:2
10 grams	calcined sodium carbonate 1:10
1kg	

Green

5.4 grams	Anthrasol Green IB
16.2 grams	Anthrasol Golden Yellow IRK
3.9 grams	Anthrasol Brown IBR
284.5 grams	hot water
120 grams	dissolving salt CN
500 grams	thickening agent
60 grams	sodium nitrite 1:2
10 grams	calcined sodium carbonate 1:10
1kg	

Brown:

14.7 grams	Anthrasol Blue IBC paste
0.9 grams	Anthrasol Golden Yellow IRK
47.4 grams	Anthrasol Brown IBR
247 grams	hot water
120 grams	dissolving salt CN
500 grams	thickening agent,
60 grams	sodium nitrite 1:2
10 grams	calcined sodium carbonate 1:10

 1kg
Olive: (padding roller)

12 grams	Anthrasol Green IB
48 grams	Anthrasol Brown IBR
270 grams	hot water
100 grams	dissolving salt CN
500 grams	thickening agent
60 grams	sodium nitrite 1:2
10 grams	calcined sodium carbonate 1:10

 1kg

The fabric printed with the anthrasol dyestuffs is dried in the chamber and rolled up. The batches of goods are wrapped in cloths in order to protect the undeveloped printing against the light. The fabric is steamed for at least 3-5 minutes in order to deepen the shade. The development takes place on the full width washing machine for 20-30 seconds at 60-80°C with

20cc sulphuric acid of 96 per cent strength (66°Bé)) per
2-4 grams Anthrasol Salt NO) litre

During the development of the anthrasol dyestuffs in the sulphuric acid bath large quantities of nitrous gases may occur which are very injurious to health (burning of the respiratory organs). Besides, a number of anthrasol dyestuffs are altered in shade by the nitrous acid being developed in the sulphuric acid bath. By the said addition of *Anthrasol Salt NO* the accumulation of the nitrous acids in the acid bath is effectively prevented. Nevertheless, it is strongly advised to remove the evolving gases by a well-working ventilator. After the acid bath the material is squeezed. In order to de-acidify, the fabric is best led at first through a trough provided with spray pipes, after the passage through a further rinsing box with an overflow the material is neutralised with dilute soda lye or 2 grams of calcined sodium carbonate per litre and laid aside. On the second run through the full width washing machine the fabric is aftertreated at boiling temperature with a brand of Igepon or Igepal and sodium carbonate, rinsed and dried on the stretcher or the drying cylinder.

Water-repellent finishing

A water column of 460mm according to Schopper is required. The fabric is treated three times on the three-roller foulard with

40 grams Persistol Base B) per
plus 10 grams Persistol Salt con.) litre

and dried on the drying cylinder, the first cylinders of which are covered in order to avoid stains. A water column of about 450-500mm is attained.

MIXTURE FOR 100 LITRES OF LIQUOR:

Yellowish-brown: (*padding roller*)

4 kg	Persistol Base B are dissolved with
25 litres	water of 80°C and stirred into a solution of
1 kg	Persistol Salt conc. in
20 litres	water. The whole is cooled at 40°C with
45 litres	cold water, there is added slowly
0.9 kg	crystallised sodium acetate dissolved in
8 litres	water. Finally
1 litre	acetic acid of 30 per cent strength (60°Bé) is added and the
	whole is adjusted to

100litres



Blouse-fabric for Parachute Troops, also Field Jackets

4-shaft double face twill 2:2 consisting of 33% spun rayon and 67% cotton,
breadth: 140cm
warp: Nm 34/2 (1 green, 1 brown)
filling: Nm 34/2 (olive)

The warp is dyed Indanthren in the staple, the filling is dyed Indanthren in the yarn. The yellow-green-red pattern is roller printed on one side with the design of the shelter half.

- i roller for rain pattern
- ii green
- iii brown

This item was printed with either Indanthrene or Anthrasol colours and made water repellent as described under "Combination Shelter Half and Ponjo". A water column of 460mm according to the Schopper test was required.

Camouflage Jackets of the "Wehrmacht"

Fabric:

- | | |
|---------------------------------|---------------------------------|
| (a) Linen Drill | (b) Mixed Yarn Drill |
| Width, raw: 88cm | Width, raw: 90cm |
| Width, finished: 83cm $\pm$ 1cm | Width, finished: 83cm $\pm$ 1cm |

Weight of fabric for 1 square metre

- | | |
|------------------------------------|------------------------------------|
| (a) Raw: 250 grams $\pm$ 15 grams | (b) Raw: 325 grams $\pm$ 10 grams |
| Finished: 220 grams $\pm$ 15 grams | Finished: 305 grams $\pm$ 10 grams |

Preliminary Treatment:

Goods for this item were not desized. Scouring was done at full width on either the jig or full width washer with:

- 0.5-1g 'Igepon' or 'Igepal'
- 2g caustic soda or soda lye of 32½%
- 1-1.5g 'Nekal' BX Extra or 'Laventin HW'

After scouring the fabric is rinsed with hot water and then cold water and given a half bleach. The fabric is finally dried on dry cans or on a tenter. It is subsequently brushed and again framed.

Prints:

The cloth is pointed with Indanthrene dyestuffs, wherein the use of Indanthrene printing Olive GW Suprafix paste is prescribed for olive shades. The 'Anthrasol' dyes are therefore not used for printing these jackets.

The printing is done with the rollers in the following sequence:

- i Blotch roller (netting) with 10g 'Nekal' EX
- ii Pad roller (yellowish brown)
- iii Water roll
- iv Roll for rain pattern (engraved with lines and strokes)
- v Olive roll
- vi Brown roll

The rollers v and vi are lightly engraved and therefore need no squeezing. If a six colour printing machine is not available two printings are necessary, e.g.:

- i blotch roller with 'Nekal' (as above)
- ii padding roller
- iii water roller

Then the fabric is dyed in a drying chamber, rolled and overprinted with

- i roller for rain pattern (lines and streaks)
- ii Olive roller
- iii Brown roller

Sometimes this second series of rolling is executed upon the white fabric, which is then dried and overprinted with yellowish brown padding (ii).

Requirement of printing colour for 100 sq.m.: ca 12kg



PRINTING COLOUR OF 'INDANTHREN' PER KG:

Yellowish brown:

60 grams	Indanthren printing Brown TMZ Suprafix paste or TMZK Suprafix paste
23 grams	Indanthren Golden Yellow RK Suprafix double paste
8 grams	Indanthren printing Black TL Suprafix paste
or	
65 grams	Indanthren printing Brown TMZ Suprafix paste
14 grams	Indanthren Yellow G double paste fine
1.6 grams	Indanthren Brilliant Green B paste fine concentrated for printing

Brown:

75 grams	Indanthren printing Brown TMZ Suprafix paste or TMZK Suprafix paste
180 grams	Indanthren Scarlet GG Suprafix paste
100 grams	Indanthren printing Black TL Suprafix paste

PRINTING COLOUR MIXTURE:

90-350 grams	Indanthren dyestuff paste
310 grams	water or thickening agent
600-650 grams	base mixture
1kg	

Base mixture:

10 grams	potato starch	) to be
10 grams	cold water) stirred,	
105 grams	cold water for diluting	
15 grams	'Cellapret' dry	
30 grams	British gum or okagum are strewn in and after good mixture	
130 grams	potash, soluted in	
130 grams	water, is stirred in. The whole is boiled for a short time and caused to cool down during stirring.	
	Subsequently -	
100 grams	Glycinal HD2 and	
120 grams	Rongalit C are added	
650 kg		

Olive colour:

910 grams	Indanthren printing Olive GW Suprafix base
90 grams	Indanthren Brilliant Green 4G base
1kg	

INDANTHREN PRINTING OLIVE GW SUPRAFX BASE (HYDRON OLIVE GX):

355 grams	potato-starch-Tragant-thickening agent or potato-starch-Cellapret-thickening agent
70 grams	caustic soda
10 grams	dissolving salt B new
100 grams	grape sugar (dextrose) for technical use, melted or starch syrup or molasses
5 grams	Setamol VS and
100 grams	water are slowly heated until solution is reached, then stirred in the cold. To this mixture are added
30 grams	sodium lye of 32½% strength (38°Bé)
30 grams	Rongalit C
300 grams	Indanthren printing Olive GW Suprafix
1 kg	

The dyestuff is profitably added to the prepared mixture, so that it is reduced as little as possible beforehand.

INDANTHREN BRILLIANT GREEN 4G BASE:

250 grams	Indanthren Brilliant Green 4G paste fine concentrated
100 grams	Glycinal HD2
30 grams	water
400 grams	Cellapret potato starch-thickening agent
120 grams	potash
100 grams	Rongalit C
1 kg	

Indanthren printing Olive GW Suprafix is to be used for greens and olives and is the main component of the rain roller. The olive shade contains sufficient printing Olive GW to produce a colour of medium depth and must not be diminished. For shallow engravings, such as photo engraved ones, the amount of this colour must be raised in certain cases to 400 grams per kilogram. The thickening agent or water to be correspondingly less. Instead of Indanthren Brilliant Green 4G other Indanthren colours suitable for camouflage printing might be used for shading the olive shades.

As the 'Heeresverwaltung' (Military Administration) nowadays demands that the goods have to live up to certain requirements, the fulfillment of which cannot be decided by printing establishments, it is recommended to assure good results to send a piece of cloth 40cm wide of the first printed sample to the undermentioned address for further examination. If this piece of fabric is designed as 'good' care must be taken, that the olive tone thus fixed is always produced according to the same recipe and in the same depth as on the sample. Changes of the recipe are to be objected to, even though the same shade and an equal depth of colour might be reached by using other dyestuff mixtures without Indanthren printing Olive GW. The previously mentioned samples are to be sent to:

I.G. Farbenindustrie Aktiengesellschaft, Coloristic Department,
(16) Frankfurt/Main-Höchst
Wittigwerk Raspenau A.G. (11a) Raspenau/Isergebirge

Development and aftertreatment:

The printed fabric is dried in a drying chamber at a temperature below 60°C and cooled by air before laying aside or rolling up. The printed goods are steamed in a rapid ager as soon as possible for 5-7 minutes and then cooled again. Developing takes place in a full width washing machine by means of acetic acid and potassium persulfate or hydrogen peroxide. In particular Indanthren Printing Olive GW requires thorough oxidation to produce full fastness. The fabric is then rinsed, (the water for rinsing is carried off at the rolling machines), aftertreated at boiling temperature with one of the Igepals or Igepons and soda, rinsed again and dried. A thorough aftertreatment is essential for acquiring rubbing fastness.

**Camouflaged Wind-Resistant Fabric
for Winter Clothes**

Fabric: Spun rayon

Width, raw: 150cm

Width, finished: 143 ± 2cm

Weight of the fabric, length 100m, width 143cm: 36.4kg.

Preliminary treatment:

The closely woven fabric is usually treated at full width, because creases and breaking cause roughening of the fabric. Consequently, jig, full width washing machine, drying cylinder, printing machine and agar must be adjusted to a width of cloth of 145-150cm, i.e. a working width of 160cm.

At first the cloth is desized on the jig.

DESIZING LIQUOR FOR 100KG OF FABRIC:

300 litres	water of 45-70°C
0.2-0.4 kg	Biolase N18 powder or C18 in the liquid state
75-150 kg	Nekal BX Extra

The fabric is passed several times through the liquor and the batch of fabric is then wrapped in cloths in order to prevent the drying of the edges. For the purpose of desizing the fabric is allowed to stand for some hours or overnight.

DESIZING WITH VIVAL E EXTRA FOR 100KG OF FABRIC:

300-350 litres	water of 45-50°C
0.8-1 kg	Vival B Extra
75-150 grams	Nekal B Extra

The Vival is stirred into five times its weight of cold water and diluted with hot water until dissolution takes place. When working with Vival the temperature must by no means exceed 55°C. For the rest the working is the same as described above.

Boiling:

Recently a separate desizing is often dispensed with and the raw fabric is directly boiled on the jig or full width washing machine with

0.5-1 gram	Igepon or Igepal	)
2 grams	calcined sodium carbonate	)
	or caustic soda solution of 32½% strength (38°Bé))	per litre
1-1.5 grams	Nekal BX Extra	)

After boiling the material is rinsed hot and cold. Formerly the fabric was partly brightened with a weak sodium hypochlorite bath or with hydrogen peroxide, acidified and rinsed. Finally, the goods are dried on drying cylinders or stenters, brushed and stentered.

Printing:

The fabrics is printed with Indanthren dyestuffs according to the potash-Rongalit-C-process. In case the printed goods cannot be steamed on the same day, use is made of the anthrasol dyestuffs prepared according to the nitrite-process, the undeveloped printings obtained by means of these dyestuffs may be stored for an almost unlimited time if they are protected against light and acid vapours. The fabric is nominally printed with the following arrangement of rollers:

- i blotch netting roller with 10 grams Nekl BX dry/1
- ii padding roller (yellow-brown)
- iii water roller
- iv roller for rain pattern
- v olive roller
- vi brown roller

The rollers v and vi are lightly engraved and therefore need no squeezing. In case no six-coloured printing machine is present, printing is performed in two processes, for example:

- i blotch roller with Nekl (as above described)
- ii padding roller
- iii water roller

The fabric is then dried in the chamber, rolled up and overprinted with

- i roller for rain pattern
- ii olive roller
- iii brown roller

At some factories this second arrangement of rollers is first printed on the white fabric, dried and overprinted as described above for the yellow-brown blotch.

Consumption of printing paste for 100 sq. m.: about 15kg.

INDANTHREN PRINTING PASTES PER KG:

Yellowish-brown:

60 grams	Indanthren printing Brown TMZ Suprafix paste
23 grams	Indanthren Golden Yellow RK Suprafix double paste
8 grams	Indanthren printing Black TL Suprafix paste
or	
65 grams	Indanthren printing Brown TMZ Suprafix paste
14 grams	Indanthren Yellow G double paste fine
1.6 grams	Indanthren Brilliant Green B paste fine concentrated for printing

Olive:

90 grams	Indanthren printing Brown TMZ Suprafix paste
55 grams	Indanthren Golden Yellow RK Suprafix double paste
37 grams	Indanthren Brilliant Green B paste fine concentrated for printing.

Brown:

75 grams	Indanthren printing Brown TMZ Suprafix paste
180 grams	Indanthren Scarlet GG Suprafix paste
100 grams	Indanthren printing Black TL Suprafix paste

PRINTING PASTE MIXTURE:

90-350 grams	Indanthren dyestuff paste
310 grams	water or thickening agent
600-650 grams	stock liquor
1 kg	

STOCK LIQUOR:

Stir

10 grams	potato starch and
10 grams	cold water, dilute with
105 grams	cold water and strew in
15 grams	Cellapret, dry, slowly stir in
30 grams	British gum or Oka gum, after good dispersion and
130 grams	potash dissolved in
130 grams	water. Boil for a short time and stir until cold.
	Then add
100 grams	Glycinal HD and
120 grams	Rongalit C
650 grams	

The printed fabric is dried in the chamber at a temperature below 60°C and cooled by an air passage before batching off or rolling up. The printed pieces are steamed as soon as possible for 5-7 minutes in a rapid ager and again cooled down. The printings are developed on the full width washing machine with the aid of acid and potassium persulfate or hydrogen peroxide then the fabric is rinsed (the rinsing water must be conducted away from the pairs of squeezing rollers), aftertreated at boiling temperature with an Igepal- or Igepon-brand and sodium carbonate, rinsed and dried.

For good fastness to crocking a thorough aftertreatment is necessary.

ANTHRASOL PRINTING PASTES:

Yellow-brown:

3.5 grams	Anthrasol Green IB
12 grams	Anthrasol Golden Yellow IRK
40 grams	Anthrasol Brown IBR
274.5 grams	water
100 grams	dissolving salt CN
500 grams	starch-tragacanth-thickening or starch-Cellapret thickening or Solvitex ST plus BG-thickening
60 grams	sodium nitrite 1:2
10 grams	calcined sodium carbonate 1:10
1 kg	

Olive:

21 or	25 grams	Anthrasol Green IB
14 or	15 grams	Anthrasol Blue IBC paste
25 or	25 grams	Anthrasol Golden Yellow IRK
45 or	— grams	Anthrasol Brown IBR
— or	37 grams	Anthrasol Brown IVD
120 or	120 grams	Dissolving Salt CN
205 or	208 grams	Hot water
275 or	275 grams	Cellapret-thickening 1:7
225 or	225 grams	British gum 1:1
10 or	10 grams	Calcined sodium carbonate 1:10
60 or	60 grams	Sodium nitrite 1:2
1kg	1kg	

Brown:

95 grams	Anthrasol Brown IBR
33 grams	Anthrasol Red IFBB
12 grams	Anthrasol Blue IBC paste
120 grams	Dissolving Salt CN
170 grams	Hot water
275 grams	Cellapret-thickening 1:7
225 grams	British gum 1:1
10 grams	Calcined sodium carbonate 1:10
60 grams	Sodium nitrite 1:2
1 kg	

Development and aftertreatment:

The fabric printed with the anthrasol dyestuffs is dried in the chamber and rolled up. The batches of goods are wrapped in cloths in order to protect the undeveloped print against the light. The fabric is steamed for at least 3-5 minutes in order to deepen the shade. The development takes place on the full width washing machine for 20-30 seconds at 60°C to 80°C with

20cc of sulphuric acid of 96 per cent strength (66°Bé))	per
2-4 grams of Anthrasol Salt NO	) litre

During the development of the Anthrasol dyestuffs in the sulphuric acid bath large amounts of *nitrous* gases occur which are very injurious to health (burning of the respiratory organs). Besides, a number of anthrasol dyestuffs are altered in shade by the nitrous acid being developed in the sulphuric acid bath. By the said addition of *Anthrasol Salt NO* the accumulation of the nitrous acids in the acid bath is effectively prevented. Nevertheless it is strongly advised to remove the evolving gases by a well working ventilator. After the acid bath the material is squeezed. In order to de-acidify the fabric is best led at first through a trough of spray pipes, after the passage through a further rinsing box with an overflow, the material is neutralized with diluted soda lye or 2 grams of calcined sodium carbonate per litre and laid aside. On the second run through the full width washing machine the fabric is aftertreated at boiling temperature with a brand of Igepon or Igepal and sodium carbonate, rinsed and dried on the stretcher or the drying cylinder.

Water-repellent finishing:

The requirement is a water-column of 200mm according to Schopper.

1. The fabric is treated three times on a three-roller pad with 80 grams of Persistol NO/1 and dried on the drying cylinder. A water column of approximately 180-250mm is obtained.

2. The fabric is padded twice on a three-roller pad with

40 grams of Persistol Base B) per
plus 10 grams of Persistol Salt conc.) litre

and dried on the drying cylinder or tenter frame.

MIXTURE FOR 100 LITRES OF LIQUOR:

4 kg Persistol Base B are dissolved with
25 litres water of 80°C and stirred into a solution of
1 kg Persistol Salt concentrated in
20 litres water

The whole is cooled to 40°C by means of

45 litres cold water
0.9 kg crystallised sodium acetate, dissolved in
8 litres water slowly added. Finally
1 litre acetic acid of 30% strength (6°Bé) is added and the whole is
adjusted to

100 litres



Linen Drill, Winter Camouflage Clothes for the "Waffen-SS"

Fabric:

1. Linen drill made from spun rayon, flax tow and mixed yarn.
Weight of the raw material, length 100m, width 80cm: 18-20kg
Width, raw: 80cm
Width, finished: 76-78cm
2. Spun rayon of high fastness to wet processing for camouflage clothes:
Weight of the raw material, length 100m, width 150cm: 50kg
Width, raw: 150cm
Width, finished: 136-137cm

Preliminary treatment:

The closely woven fabric is usually treated at full width in order to avoid creases and breaking. The raw material is boiled on the jig or the full width washing machine with

0.5-1 gram	Igepon or Igepal
2 grams	calcined sodium carbonate or soda lye of 32½% (38°Bé)
1-2 grams	Nekal BX extra per litre

After boiling the fabric is rinsed hot and cold. Then it is dried on the drying cylinder or on the stenter, brushed and stentered.

Printing:

On the one side the goods are padded yellow-brown (khaki) by means of anthrasols whereas the other side is printed with five colours.

The new pattern is produced by machine printing with Indanthren dyestuffs, but it is also printed with Anthrasol dyestuffs according to the nitrite process. With the anthrasol printing process it is, for example, possible to print at first for a whole week only one side of the fabric and to batch up the non-developed fabric whereupon, in the following week, the reverse side may be printed. This offers favourable possibilities of production.

INDANTHREN PRINTING PASTES:

Light-brown	Green	Olive	
100 grams	— gram	80 grams	Indanthren Printing Brown TMZ
			Suprafix paste
5 grams	75 grams	80 grams	Indanthren Golden Yellow RK
			Suprafix double paste
— gram	75 grams	— gram	Indanthren Brilliant Green 4G paste
			fine concentrated
— gram	— gram	25 grams	Indanthren Brilliant Green B paste
			fine concentrated
245 grams	180 grams	145 grams	water
80 grams	80 grams	80 grams	Glycinal HD
350 grams	350 grams	350 grams	potato-starch-Cellapret dry
			thickening agent
120 grams	120 grams	120 grams	potash
100 grams	120 grams	120 grams	Rongalit C
1kg	1kg	1kg	

Dark-brown Dark-green

80 grams	90 grams	Indanthren Black Brown R paste for printing
100 grams	— gram	Indanthren printing Brown TMZ Suprafix paste
— gram	70 grams	Indanthren Blue Green FFB Suprafix double paste
— gram	50 grams	Indanthren Brilliant Green B paste fine concentrated
— gram	25 grams	Indanthren Golden Yellow RK Suprafix double paste
170 grams	120 grams	water
80 grams	100 grams	Glycinal HD
350 grams	300 grams	potato-starch-Cellapret dry thickening agent
120 grams	120 grams	potash
100 grams	120 grams	Rongalit C
1kg	1kg	

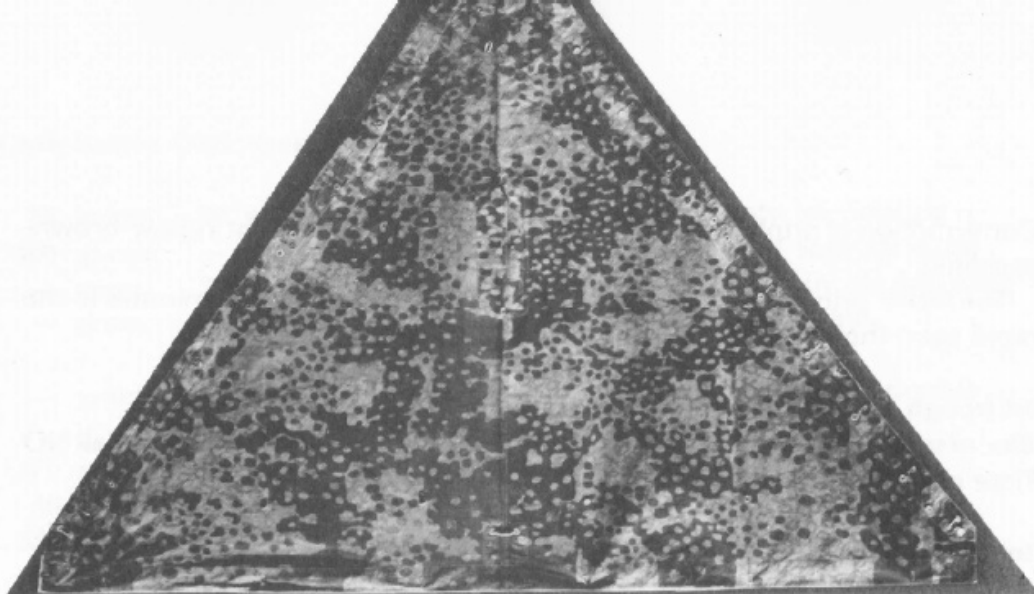
Steaming and development are as usual for Indanthren printing.

ANTHRASOL PRINTING PASTES:

Light-brown	Green	Olive	
10 grams	40 gram	40 grams	Anthrasol Golden Yellow IRK
— gram	15 grams	10 grams	Anthrasol Green IB
42 grams	6 grams	25 grams	Anthrasol Brown IBR
10 grams	— gram	— gram	Anthrasol Brilliant Orange IRK
100 grams	120 grams	120 grams	Dissolving Salt CN
20 grams	30 grams	30 grams	Fibrite D
250 grams	250 grams	250 grams	hot water
20 grams	— gram	— gram	urea
20 grams	20 grams	20 grams	calcined sodium carbonate 1:10
350 grams	350 grams	350 grams	potato-starch Cellapret dry thickening agent
60 grams	50 grams	60 grams	sodium nitrite 1:2
118 grams	119 grams	95 grams	cold water
1kg	1kg	1kg	

Dark-brown Dark-green Yellow-brown-padding

60 grams	55 grams	22 grams	Anthrasol Brown IBR
7 grams	— gram	— gram	Anthrasol Blue IBC paste
— gram	10 grams	15 grams	Anthrasol Golden Yellow IRK
— gram	40 grams	— gram	Anthrasol Green IB
— gram	15 grams	— gram	Anthrasol Grey IBL
100 grams	120 grams	80 grams	Dissolving Salt CN
20 grams	30 grams	20 grams	Fibrit D
250 grams	300 grams	250 grams	hot water
20 grams	20 grams	20 grams	sodium carbonate calcined 1:10
350 grams	350 grams	350 grams	potato starch-Cellapret dry thickening agent
50 grams	60 grams	50 grams	sodium nitrite 1:2
143 grams	— gram	193 grams	cold water
1kg	1kg	1kg	



SS Shelter Half

Fabric: 33/67 Spun rayon-cotton-mixed fabric

Width, raw: 140-145cm

Width, finished: 132-134cm

Weight of the raw material for 100m,

width: 140cm, corresponding to the yarn thickness and to the setting of the goods from 37.5 to 42.5kg.

Preliminary treatment:

The closely woven fabric is usually treated in full width, since creases and breaking cause unremovable roughening of the fabric. Jigs, open soaper, drying cylinder, printing machine and ager have, therefore, to be adjusted for handling goods of a width of 140-145cm, and their working width has to amount to 160cm.

Attempts have been made to avoid the process of boiling with Igepal and soda, in order to obtain a finished fabric showing an increased water repellence and standing a higher water column according to Schopper. This change, however, to a short desizing and chlorinating of the goods, provoked irregular wetting and levelling during the printing process.

At first the fabric is desized on the jig.

DESIZING LIQUOR FOR 100kg OF GOODS:

300 litres of water (temperature: 45°C - 70°C)

200-400 grams of Biolase N18 powder or C18 liquid

75-150 grams of Nekal BX extra

The fabric is repeatedly passed through the liquor. The batch of fabric is then wrapped in cloths in order to prevent drying of the borders. For desizing the goods are allowed to stand for several hours or during the night.

DESIZING OF 100kg OF THE FABRIC WITH VIVERAL E extra:

300-350 litres of water (temperature: 45-50°C)

0.8-1kg Vival E Extra

75-150 grams of Nekal BX extra

The Vival is introduced into five times its weight of cold water, while stirring. The mixture is diluted with warm water until a solution is obtained. When using Vival the temperature is by no means allowed to exceed 55°C. The desizing is then carried out as described above.

Boiling:

Recently a separate desizing is often omitted; the raw fabric being boiled on the jig or on the open soaper with

0.5-1 gram	Igepon or Igepal	)
2 grams	calcined soda or caustic soda lye	) per litre
1-1.5 grams	Nekal BX extra	)

After boiling, the goods are rinsed hot and cold. Formerly the fabric was partly bleached in a mild bath of sodium hypochlorite or by means of hydrogen peroxide, acidulated, and rinsed. Finally, the goods are dried on the drying cylinder, brushed and stentered.

Printing:

The SS-fabric is film-printed (screen printed) on both sides in three colours usually with Anthrasol dyestuffs, occasionally also with Indanthren dyestuffs. Of late this article is also produced by simultaneously combining machine printed Indanthren dyestuffs with film-printed Anthrasol dyestuffs, the large dark areas being either bottom-printed or subsequently overprinted with Anthrasols by means of screens. This combination yields a larger production than screen printing alone.

SCREEN-PRINTING COLOURS CONTAINING ANTHRASOL DYESTUFFS:

Dark-green	Leaf green	Brown ground	
60 grams	3.5 grams	23 grams	Anthrasol brown IBR
15 grams	6.5 grams	— grams	Anthrasol green IB
— gram	16 grams	0.6 grams	Anthrasol Golden Yellow IRK
— gram	— gram	3.0 grams	Anthrasol Blue IBC paste
100 grams	120 grams	80 grams	Dissolving Salt CN
30 grams	20 grams	20 grams	Fibrite D
190 grams	229 grams	268 grams	hot water
275 grams	275 grams	275 grams	Cellapret thickening 1:7
250 grams	250 grams	250 grams	British gum 1:1
20 grams	20 grams	20 grams	calcined soda 1:10
60 grams	60 grams	60 grams	sodium nitrite 1:2
1kg	1kg	1kg	

Dark-brown	Leaf green	Brown ground	
41 grams	19 grams	17 grams	Anthrasol brown IBR
12 grams	— gram	5 grams	Anthrasol Blue IBC paste
— gram	7.5 grams	0.5 grams	Anthrasol Golden Yellow IRK
180 grams	100 grams	80 grams	Dissolving Salt CN
30 grams	30 grams	20 grams	Fibrite D
132 grams	238 grams	272 grams	hot water
275 grams	275 grams	275 grams	Cellapret thickening 1:7
250 grams	250 grams	250 grams	British gum 1:1
20 grams	20 grams	20 grams	calcined soda 1:10
60 grams	60 grams	60 grams	sodium nitrite 1:2
1kg	1kg	1kg	



1932 The First Pattern



1941 Wehrmacht half-burred edge



1942 Luftwaffe Pattern



1942 Variant of Luftwaffe Pattern



1945 New Lieber Pattern.
Selected for all units.



1944 Late Pattern. Not Adopted



This infra-red photograph shows the effect of incorporating carbon into the camouflaged uniform material. Left: figure without carbon; Right: figure with 4% carbon.

The fabric, printed on both sides and dried is steamed for 3-5 minutes in a rapid ager or for 10-12 minutes on the star frame. The depth of colour of Anthrasol Golden Yellow IRK, Anthrasol Green IB and Anthrasol Brown IBR is considerably increased by previous ageing. The fabric is then developed on the full width machine.

Example:

1st trough (acid proof, of pitchpine, or lined with lead-plates):

20ccm of

sulphuric acid 66°Bé

plus 2 grams of Anthrasol Salt NO

time of passage: 20-20 seconds

) per

) litre

) at 70°C

2nd and 3rd trough: spraying with cold water and rinsing.

4th trough: neutralizing with 2 grams of calcined soda per litre.

5th and 6th trough: rinsing.

During the night the developed fabric is immersed at full width in a desizing liquid containing Biolase N18 powder, or Vival E extra and on the next day rinsed at full width. At the second passage through the open soaper the goods are treated at the boil with a brand of Igepon or Igepal and with soda, rinsed and then dried on the stenter.

FILM PRINTING, COLOURS CONTAINING INDANTHREN DYESTUFFS:

Dark-green	Leaf green	Brown ground	
60 grams	— gram	107 grams	Indanthren Black Brown R paste for printing
42 grams	— gram	— grams	Indanthren Olive Green B fine powder
— gram	72 grams	16 grams	Indanthren Golden Yellow RK Suprafix double paste
— gram	48 gram	— gram	Indanthren Brilliant Green 4G fine paste, concentrated
278 grams	200 grams	257 grams	water
80 grams	100 grams	80 grams	Glycinal HD
150 grams	150 grams	150 grams	British gum 1:1
200 grams	200 grams	200 grams	Cellapret thickening 1:7
40 grams	50 grams	40 grams	calcined soda
50 grams	60 grams	50 grams	potash
100 grams	120 grams	100 grams	Rongalit C
1kg	1kg	1kg	

Dark green	Yellow brown	Light brown ground	
130 grams	30 grams	83 grams	Indanthren Black Brown R paste for printing
15 grams	— gram	8 grams	Indanthren Olive Green B fine powder
20 gram	170 grams	8 grams	Indanthren Yellow Brown 3G Suprafix double paste
155 grams	170 grams	282 grams	water
100 grams	100 grams	80 grams	Glycinal HD
150 grams	100 grams	150 grams	British gum 1:1
200 grams	200 grams	200 grams	Cellapret thickening 1:7
50 grams	50 grams	40 grams	calcined soda
60 grams	60 grams	50 grams	potash
120 grams	120 grams	100 grams	Rongalit C
1kg	1kg	1kg	

The fabric, printed on both sides and dried, is steamed in the rapid ager or on the star frame for 6-10 minutes and developed on the open soaper.

Example:

1st trough: 3ccm of hydrogen peroxide of 30% strength) per
plus 5ccm of acetic acid of 30% strength (6°Bé)) litre

2nd trough: spraying with cold water and rinsing.

3rd and 5th trough: aftertreating with Igepal and soda at the boil.

6th trough: rinsing.

MIXED PRINTING BY MEANS OF ANTHRASOL AND INDANTHREN DYESTUFFS:

1. Anthrasol bottom print by means of film screens.

The face of the SS-awning is printed with Dark Green, the back with Dark Brown, as previously mentioned. Then the fabric is dried, aged and developed with sulphuric acid as usual.

2. Indanthren overprint on the printing machine.

Face: per kg printing paste:

LEAF GREEN:	100 grams	Indanthren Brilliant Green 4G fine paste concentrated
	70 grams	Indanthren Golden Yellow RK Suprafix double paste
BROWN GROUND:	150 grams	Indanthren Black Brown B paste for printing
	20 grams	Indanthren Brilliant Orange RK Suprafix paste

Back:

per kg printing paste:

YELLOW BROWN:	170	grams	Indanthren Yellow Brown 3G Suprafix double paste
	30	grams	Indanthren Black Brown R paste for printing
LIGHT BROWN GROUND:	120	grams	Indanthren Black Brown R paste for printing
	20	grams	Indanthren Golden Yellow RK Suprafix double paste
	10	grams	Indanthren printing Navy Blue RR Suprafix paste

PRINTING PASTE MIXTURE:

150-200	grams	Indanthren dyestuff
250-150	grams	water or thickening agent
600-650	grams	stock mixture
1kg		

STOCK MIXTURE:

10	grams	potato starch are made into a paste with
10	grams	cold water, diluting the paste with
105	grams	cold water, stewing in
15	grams	Cellapret dry and
30	grams	British gum or Okagum, after good dispersion introducing, while stirring
130	grams	potash, dissolved in
130	grams	water, boiling the mixture for a short time and stirring it until it is cold, then adding
100	grams	Glycinal HD and
120	grams	Rongalit C
650		grams

The overprinted fabric is aged and developed as is usual with Indanthren dyestuffs. With the same success it is possible to at first bottom-print with Indanthren dyestuffs on the machine and then to overprint the developed prints with the dark areas with Anthrasol printing colours by means of screen printing.

Water-repellent finish on the jig or on the foulard (padder)

Corresponding to the count of yarn and to the set of the goods, the fabric has to stand a water column of 350-450mm according to Schopper.

- a) 4 passages on the jig with
70 grams of Ramasit KGT concentrated) per litre
plus 10 grams of Tonalon)

partly drying on the stenter and finally drying on the drying cylinder.

- b) The fabric is thrice passed through 80 grams of Persistol NO
per litre on the three-roller foulard and is dried on the
drying cylinder.



Recipe for Printing and Finishing the So-called “Leiber”-pattern on Camouflaged Fabrics for Winter Clothes and Awnings (Shelter Halves)

Constitution of the fabric: 100% spun rayon

Width in the raw state: 151cm plus 2cm

Width in the finished state: 143cm plus 2cm

For all operations the goods have to be run only at full width.

METHOD OF WORKING:

Printing:

The goods have to be printed on one side with the combination of colours to be seen from the annexed sample. The printing is carried out by means of six rollers, having different circumferences in order to avoid a regular repeat of pattern. The printing is effected in two stages with intermediate ageing.

1st printing:

A simultaneous printing is carried out by means of the two black rollers having different circumferences.

Roller for large black pattern:	44.1cm circumference
Roller for small black pattern:	50.5cm circumference

The large black pattern is printed last. The distribution of the black portions may be learned from the roller prints. Aniline black is used as black colour.

Intermediate ageing:

Before the second printing the fabric has to be aged as usual when printing with aniline black.

2nd printing:

The printing is carried out by means of four rollers.

red pattern	roller with 46.2cm circumference
large green pattern	roller with 48.2-49cm circumference
small green pattern	roller with 49cm circumference
ground pattern	roller with 49cm circumference

The two last named rollers are printed last, in such a manner, that the small green pattern is purposely not printed in proper repeat of design so that the fabric is not entirely covered with colour but at certain places is left white as may be seen from the annexed sample. The green and the scarlet patterns are overprinted by the other rollers without being in repeat with each other.

Recipes of printing colours:

Aniline black according to a special formula; large green pattern 150 grams of Indanthren Brilliant Green 4G fine concentrated/kg printing colour; scarlet pattern: 150 grams of Indanthren Scarlet GG Suprafix paste/kg printing; small green pattern: colour of this large green pattern reduced 1:1.

GROUND:	30	grams Indanthren printing Brown TMZ	
		Suprafix paste	)
	15	grams Indanthren Yellow G double paste)	reduction 3:1
	2.5	grams Indanthren Brilliant Green B paste	
		fine concentrated	)

Instead of the above named brands of Brilliant Green, other brands of these dyestuffs, suitable for printing may be applied. Instead of Indanthren Yellow G, Indanthren Golden Yellow RK Suprafix double paste may be used, or Indanthren Yellow 3G Suprafix double paste, which yield a corresponding shade.

The engravings of the black roller printing last and of the rollers for the small green pattern and the ground pattern may be produced in the normal depth necessary for the covering of the fabric. The black roller, printing first and the rollers printing the large green and scarlet patterns need an engraving of less depth, preferably photo engraving.

The circumferences of the rollers, indicated above, have to be strictly observed, a change of the circumferences giving rise to another distribution of the individual portions of the pattern and of the colours and, consequently, to a change of the pattern as a whole.

If rollers, showing the prescribed circumferences should not be available, the Verteilungsstelle (distributing office) has to be informed of this fact and of the circumferences on hand. This office will advise the printers of allowed deviations (if any) in each particular case.

Ageing:

The goods are aged in a rapid ager in the manner usual when printing with Indanthren colours.

Washing and Soaping

A thorough washing is necessary with regard to the fastness to crocking.

Finishing:

Must be finished fast to scouring and to water pressure. The control test, using the 'Schopper' apparatus for measuring the permeability to water, must show a water column of at least 250mm. The goods have to be finished in such a manner, that using a washing test according to the Dahlemer method the residual shrinking does not exceed 5% in the warp and 3% in the filling.

The following is a complete report, covering this item, by the Neue Augsburger Kattunfabrik plant in Augsburg.

Fabrics processed:

- 1 Drill
- 2 Twill
- 3 Raw Linen

Preparation of the Cloth:

If the cloth is an all rayon and free of starch it was printed in the grey. Otherwise all fabrics were desized and if necessary bleached. The bleaching is preferably done with NaOCl, under exact control of the active chlorine, to avoid tendering of the fibre. The fabric was then given an anti-chlor, scoured, rinsed, extracted and dried. All cloth was brushed before printing.

Printing:

The cloth was plaited in boxes after brushing and was run directly on the print machine from the box. Two runs through the print machine were necessary to produce the new pattern (Leiber).

Aniline black was produced first, according to the following directions:

120 grams	Aniline salt dissolved
	in
490 grams	Thickening agent KG
40 grams	Chlorate of soda dissolved
	in
80 grams	Water
80 grams	ferrocyanide of Soda dissolved
	in
120 grams	Water

THICKENING AGENT KG:**1 portion potato-starch thickening 120/1000****1 portion Colloresin V thickening 150/1000.****50 grams Acetic Acid 50%****20 grams Kollamin****1kg**

After printing and drying a short steaming in the ager (2 minutes) takes place. Then the fabric goes immediately to be overprinted.

The overprint is four coloured:

1st Colour—red**60 grams Rapidogen-scarlet IL****30 grams Spirits****22 grams Lye 38°Bé****650 grams S St thickening agent****5 grams Lye 38°Bé****233 grams Water****1kg****2nd Colour—dark green****48 grams Anthrasol Green IB****32 grams Anthrasol print Yellow GOK****50 grams Glycinal HD****30 grams Dissolving Salt CN****280 grams Water****500 grams Thickening agent KG****10 grams Soda 1:10****50 grams Nitrite solution 1:2****1kg****3rd Colour—light green****1 portion green dark****2 portions thickening agent KG****4th Colour—tan base****11.3 grams Anthrasol Golden Yellow IRK****3.3 grams Anthrasol Brown IBR****5.3 grams Anthrasol Grey IBL****10 grams Dissolving Salt CN****17 grams Glycinal HD****363.1 grams Water****550 grams Thickening agent KG****10 grams Soda solution 1:10****30 grams Nitrite solution 1:2****1kg****S ST THICKENING****65 kg Secunda wheat starch****10 kg Solvitex St****100 kg Tragant 100/1000****600kg**

After printing the fabric was thoroughly dried. It was then given a 12 to 15 minute ageing in a neutral ager followed by an 8 minute acid (acetic) ageing. Further developing and washing was done on a full width washer. The first box was charged and maintained with approximately 20cc H_2SO_4 (66°Bé) per litre, at 60°C. The cloth was given a short airing, over rolls, between boxes, water rinsed, then a mild alkaline wash, followed by water rinse and then given an enzyme in the last box. The cloth was allowed to remain overnight or for six hours after which it was hot and cold water washed either full width or in the rope, depending on the nature of the fabric.

After drying the cloth was made water repellent with Persistol Base and Persistol Salt applied on the three roll padder followed by drying on dry cans.

PERSISTOL BATH:

Mix No. 1: 12 kilograms of Persistol base are melted and emulsified in 60 litres of warm water.

Mix No. 2: 4 kilograms of Persistol salt are dissolved in 40 litres of warm water.

Mix No. 2 is then slowly stirred into Mix No. 1 and 48 litres of warm water (40°C) added. 3.6 kilograms of Acetate of Soda are dissolved in 30 litres of warm water and added to the above. Then 2 litres of 60% Acetic Acid are added and the mix bulked to 200 litres. Care should be taken that the temperature does not exceed 40°C.

For jacket and uniform fabrics a water repellent known as 'Hydrophobol' was used. This is a project of Chem. Fabrik Pfersee in Augsburg and it is similar to Persistol NO,

Made up	16 kilograms Hydrophobol
	184 litres water
	200 litres

The fabrics are often partially dried on cans and frame dried to width.

The size of the printing rolls differ.

Black Print	2 rolls 50.5 and 44.1cm in circumference
Red	46.2cm in circumference
Dark Green	48.2cm in circumference
Light Green	49cm in circumference
Tan	50cm in circumference

These sizes are specified by the Army and must be used.

The following are formulae made up using Indanthren printing Olive GW, which was found to be much more satisfactory than any previous colour as far as infra-red reflectance was concerned.

1st roller:	roller for rain pattern olive
2nd roller:	brown
3rd roller:	olive
4th roller:	Beige shade ground
5th roller:	water roller

Olive:

10 parts	Indanthren printing Olive GW-stock
1 part	Indanthren Brilliant Green 4G-stock

INDANTHREN OLIVE PRINTING GW STOCK:

300 grams	Indanthren printing Olive GW Suprafix
80 grams	Glycinal HD
380 grams	thickening
10 grams	dissolving salt
70 grams	calcined soda
30 grams	caustic soda solution OH 38°
100 grams	molten glucose
30 grams	Rongalit C

1kg

INDANTHREN BRILLIANT GREEN 4G-STOCK:

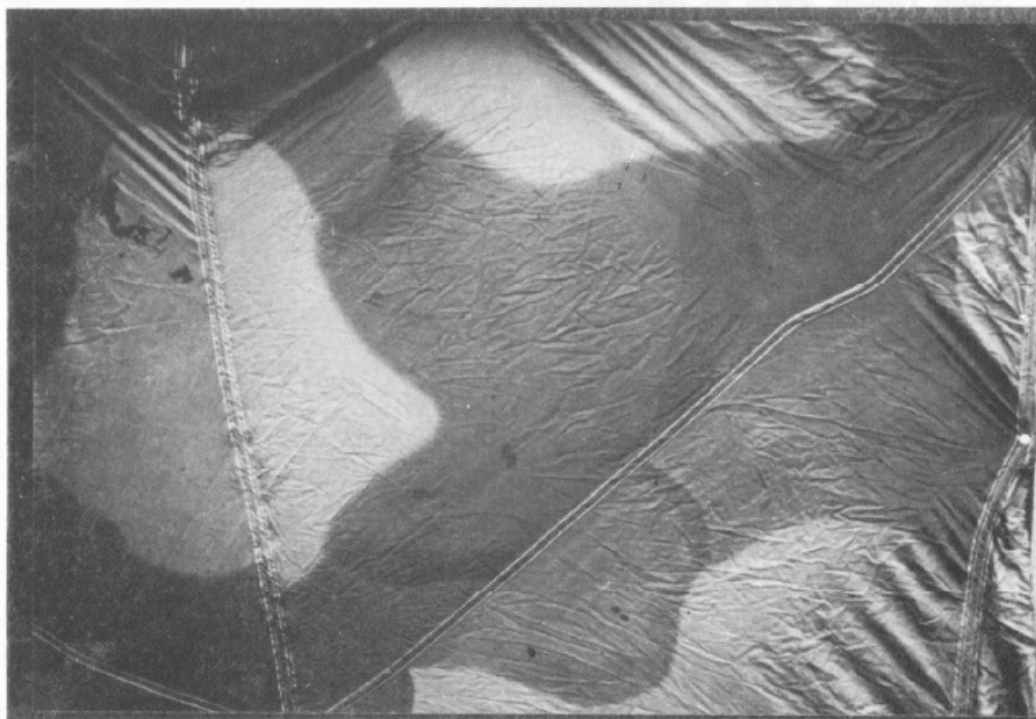
250 grams	Indanthren Brilliant Green 4G paste, fine concentrated
100 grams	Glycinal HD
30 grams	water
400 grams	thickening
100 grams	Rongalit C
120 grams	potash

1kg

Brown:

75 grams	Indanthren printing Brown TMZ Suprafix paste
100 grams	Indanthren printing Black TL Suprafix paste
170 grams	Indanthren Scarlet GG Suprafix paste
50 grams	Indanthren Brilliant Pink 3B double paste for printing

for continuation see "Indanthren Brilliant Green 4G-Base"



Green:**12 grams/litre Alliton Brilliant Green 3G****6 grams/litre Benzo Dark Green G****Dark Brown:****12 grams/litre Diamine Fast Grey KLSN****7.5 grams/litre Supramine Brown G**

Printing of Nylon Parachute Cloth

Fairly large quantities of nylon were printed for use as parachutes for the German Air Force. The cloth used was very much the same as that used by the U.S. Army Air Forces.

The fabric was scoured full width on rolls, on equipment that permitted the rolls and cloth to be submerged in the scouring bath at all times. The apparatus is quite similar to what is commonly known as a French Boil Off machine. Scouring is accomplished by using a bath made up of 6 grams per litre of olive oil soap, brought to the boil and the fabric run in this bath for a period of twenty minutes to half an hour. This bath is dropped and a fresh one made up, containing 2 grams per litre of Igepon T. Cloth is run in this bath for ten to fifteen minutes, after which the solution is run off and the goods rinsed first with hot water, then with cold. This scouring is the only setting, or fixing as they call it, that the cloth receives. After scouring the fabric was tenter frame dried and put up on rolls preparatory to printing.

They used a pattern which had a repeat of 110 centimetres or approximately three yards in length. This could not be run on a print machine with the normal size rollers. A print machine was altered to accommodate large rollers and special rolls made to do the work. These rolls were made of wood on which was fastened sheet rubber in which the pattern had been engraved. In engraving, the pattern was raised instead of depressed as is the usual practice. The face of the raised portions, which applied the colour to the fabric were not lined, etched or roughened in any way. The colour was put in a colour box equipped with a furnishing roll. This roll revolved in the colour and came in contact with the raised portions of the rubber on the roll thus supplying them with colour. It is obvious from this method that no doctor blades were necessary.

Printing was done with a water paste containing a small amount of thickening agent, such as textile gum or water soluble cellulose. The fabric was then steamed for about one hour on a star steamer, but not washed. The water thin paste did not alter the air permeability and as there was no colour fastness requirements, it was not necessary to wash the cloth. The type of printing roller employed did not give a sharp line, nor smooth, even colour, this however was considered an asset rather than a drawback. The pattern was a three colour one with one hundred per cent coverage.

Print formulae are as follows:

Beige:**18 grams/litre Benzo Light Brown BL****18 grams/litre Supramine Brown G**

Beige shade for ground:

60 grams	Indanthren printing Brown TMZ Suprafix paste
10 grams	Indanthren Golden Yellow RK Suprafix paste
2 grams	Indanthren Brilliant Green B paste fine concentrated
	for continuation see "Indanthren Brilliant Green 4G stock"
	reduced 2/1

Steaming in Mather-Platt ager, oxydising, washing, soaping at the boil.

Specifications:

Air Permeability:	700 $\pm$ 100 litres of air per square metre, per second with a 16 millimetre water column
Warp Strength	35-40 kilograms per 5cm
Filling Strength	35-40 kilograms per 5cm
Warp Elongation	20%
Filling Elongation	20%
Weight	40-50 grams per square metre
Finished Width	89.7-90.7 centimetres



Anorak Cloth for Reversible Jackets

This was so named because of its similarity to Eskimo jackets made from pelts with tan coloured fur on the one side and white hide on the other. This item also found use in the Russian campaign. It was printed tan on the one side, the other side being reversed white, and made water repellent. Procedure was as follows:

ANORAK—FIELD JACKETS, WITH WHITE BACK:

Goods: plain cloth spun rayon

Width: 140-143cm

Yarn of spun rayon Nm 50/2

Weight of raw fabric, length 100cm, breadth 140cm: 32.5-34.5kg

Preliminary treatment:

The closely woven fabric is usually treated in full width, in order to avoid creases and breaking. On the jig or the open width washing machine the raw goods are boiled with per litre:

0.5-1 grams Igepon or Igepal

2 grams calcined Soda or caustic soda solution of 32½% strength (38°Bé)

1-2 grams Nekal BX extra

After the boiling the fabric is rinsed hot and cold, then dried on a drying cylinder or a stenter, brushed and stentered.

Printing:

The yellow-brown ground is printed with Anthrasols or with Indanthren-dyestuffs. Blotting to the unprinted side is to be avoided. For producing this print style, Anthrasols are generally preferred, because they level better and allow the exact shade to be obtained with greater uniformity than by printing with Indanthren's Hatching rollers (26-30 hatchings/cm).

ANTHRASOL PRINTING COLOUR:

25-30 grams Anthrasol Brown IBR

13-16 grams Anthrasol Olive Green IB

120 grams Solutionssalz CN

274 grams hot water

500 grams thickening of potato starch, Colloresin KH, Solvitex BG

40 grams sodium-nitrite 1:2

20 grams Calcined soda 1:10

1kg

Consumption of printing colour per 100 square metres is 11kg.

The printed fabric is dried and wrapped into cloths to prevent action of light. The steaming requires at least 3-5 minutes. The development is carried out at full width during 20-30 seconds at 60-80°C with

20ccm sulphuric acid of 96% strength (66°Bé)	) per
plus 2-4 grams Anthrasolsalz NO	) litre

After being thoroughly rinsed, the fabric is aftertreated with Igepal or Igepon and soda at boiling temperature.

INDANTHREN PRINTING COLOUR PER KG:

6-6.5 grams	Indanthren Olive Green B fine powder
48-42.5 grams	Indanthren printing Brown TMZ Suprafix paste

Printing colour:

54-49 grams	Indanthren dyestuff
246-251 grams	water or thickening
700 grams	stock mixture
1kg	

STOCK MIXTURE:

Making to paste	15 grams	potato starch, stir
with	15 grams	cold water
diluting with	200 grams	cold water and
dusting in	20 grams	Colloresin KB or Cellapret dry, boiling the mixture for a short time, stirring it, until it is cold,
adding	120 grams	potash, dissolved in
	130 grams	water, then adding
	100 grams	Glycinal HD, and
	100 grams	Rongalit C while stirring
700kg		

Consumption of printing colour per 100 square metres is 13.5kg.

Finishing:

The printed fabric is dried in a drying chamber at a temperature below 60°C and cooled down in an air passage before cutting or batching up. As soon as possible the pieces have to be steamed in a rapid ager for 5-7 minutes and rapidly chilled again. The development is carried out on the full width washing machine with acetic acid and potassium or ammonium persulphate or with hydrogen peroxide. After having been rinsed the fabric is treated at boiling temperature with a brand of Igepal or Igepon and soda, rinsed and dried.

Water-repellent finish:

It is required that a fabric of spun rayon stands a water column of 250mm height according to Schopper. The goods are treated on a jig with 3.5-4% Persistol NO (calculated upon the weight of the finished product) or with

**2.5% Persistolgrund B
plus 0.7% Persistolsalz conc.**

and are dried on the drying cylinder.

The fabric is then thrice conducted through

**30 grams Persistolgrund B
plus 10 grams Persistolsalz conc.**

) per
) litre

in a three-roller foulard and dried on the stenter.

MIXTURE FOR 100 LITRE DYEBATH:

3 kg	Persistolgrund B are dissolved in
20 litres	water of 80°C and the solution is introduced into a solution of
1 kg	Persistolsalz conc. in water while stirring.
	The mixture is cooled down to a temperature of 40°C by adding
40 litres	cold water
0.9 kg	sodiumacetat cryst. dissolved in
8 litres	water, slowly added. Finally
1 litre	acetic acid of 30% strength (6°Bé) is introduced, and the mixture
	is made up to

100 litres



Camouflage Jackets, Covers for Steel Helmets with White Back. Mosquito Tulle. All-linen Yarn. All-Cotton and Mixed-Cotton Yarn. Twilled Drill with Grey-Black Backside for the 'Arbeitsdienst' (Labour Service)

Material: Width of the untreated material 83/84cm and 90cm respectively.

All these goods are printed by means of Indanthren dyestuffs or Anthrasols with the pattern of the dark side (olive ground) of the shelter half, the printing not being allowed to blot to the reverse side of the material.

The pre-treatment, printing colours olive, green and brown and development thereof are the same as in the case of the shelter half.

Consumption of printing colour for 100 sq.m. of spun rayon: about 13.4 kilos.

Mosquito tulle is printed on relief type printing machines with Indanthren colours using the Colloresin process. It is also printed on regular print machines with engraved rollers with both vat colours and Anthrasol colours.

Wind Jackets, Dyed Field Grey with a White Back

Material: Spun rayon with two ply yarn in the filling.

Width of the material in the raw state: 130-135cm

Width of the material in the finished state: 120 ± 2cm

Weight of the raw material, 100m long, 135cm wide: 32.4-34.5 kilos.

The goods are originally dyed with Indanthren colours, after which one side is roller printed with a pigment white or it is pigment white coated on a coating machine. The white print or coating must have good resistance to weathering and must pass a cold crack test of -40°C.

Two padding rolls may be used for printing, leaving a shallow engraving and about 26 lines per cm. Blotch (style) or reticulated rolls level better. By printing twice on a padding roller with intermediate drying the dyed ground is covered better than by printing once with two rollers.

For the white print the following are used:

Mattweiss W, which already contains a pigment and Mowilith D32 and D41 together with white pigments; titanium dioxide, Lithopone W1R, Silverseal, Silverseal WD and if required small additions of zinc white, talc, chalk or heavy spar.

PRINTING PASTE FOR MATTWEISS W:

500 grams	Mattweiss W (Polyvinyl Acetate Emulsion)
200 grams	water
270 grams	tragacanth-thickening 60/1000 or Cellapret dry 1:10 or Colloresin KB 15:85 neutralized by means of HCL or Colloresin DKL 40/1000
30 grams	oxalic acid 1:4 dissolved in water



Coated Netting made of Paper Twine

Fair sized quantities of this material were procured but it was not considered a large item.

The twine from which the nets were made was given a mildew proofing and water repellent treatment before weaving. This was done with Preventol S.P. and Persistol NO. The Preventol S.P. is a milder proofing agent of poor fastness to water or leaching and is made much faster by the use of the water repellent agent, Persistol NO.

After weaving, a light calendering is given to the netting to make it as smooth as possible. This calendering must not be done with too much pressure or the yarns will cut each other.

Much of this netting was made white by padding through a pigmented solution of polyvinyl acetate in the usual manner. Also produced was a two-sided net, one side of which was white the other tan. The calendering is very important in producing a good result when giving this two sided treatment. Both the white and tan coatings are pigmented polyvinyl acetate. Some of this work was done on printing machines in two runs. One colour being applied on one side in the first run, the other on the reverse side on the second run. Other yardage was done on three bowl padders by using the bottom bowl as a furnisher to the middle bowl, which was stippled or engraved with many fine holes. This bowl was cleaned with a doctor blade as on a regular printing machine. The netting was passed between the middle bowl and the top one, with very light pressure on the top bowl.

The coated netting was subjected to one test which was a cold crack. This test was conducted by placing a piece of netting in dry ice for half an hour, removing and wrapping it in a cloth and crushing by hand. The specification called for no cracking at minus 40°C Centigrade. The use of polyvinyl acetate precluded the possibility of obtaining such a result and the priority on this item was too low to obtain a more suitable medium for coating.

The following is a description of various methods of producing this item, however the preceding methods as far as equipment and material were concerned, were generally used.

White Camouflage Nets and Fabrics of Paper Thread

The grey-brown raw goods cannot be lightened to the required degree by bleaching without a considerable decrease in resistance to tearing. A useful method for producing fabrics for white camouflage consists in applying white pigments with a binding agent. The following printing and finishing processes are practically employed:

1. **Brush printing (brush)**
2. **Spray printing (spray gun)**
3. **Padding on a two-roller foulard, the lower roller)
of which dips into the padding bath) for close meshed,**
4. **Coating by means of a doctor on a simple coating) plain goods
appliance**

It cannot be avoided that a considerable proportion of the printing colour falls through the meshes of the nets. In the printing process, therefore, 3-4 layers of the nets are, as a rule, superimposed so that the printing colour which falls through the upper layers is received by the lower layers. In the spray-printing process, means for collecting and carrying back the sprayed colour have to be provided.

The following white pigments are used:
Kronos—titanium dioxide, titanium dioxide brands,
Lithopone WIR, Silbersiegel, Silbersiegel WD, and, if required, small additions of zinc white, talcum, chalk or heavy spar.

The most essential binding agents are:
Mattweib (dead white) W, already containing a pigment, Mowilith D32 and D41, Serikjose LCK extra and albumen.

PADDING COLOUR FOR MATTWEIB W:

300 grams	Colloresin DKL 40:1000
400 grams	Mattweib W
200 grams	Kronos-Titanium dioxide 1:1
80 grams	water
20 grams	glycolic acid of 70% strength
1kg	

The paper fabrics run through nips, the lower roller of which applies the padding colour. The goods are then dried, e.g. in a hanging room. In order to obtain the condensation of the Mattweib the fabric is passed with its white side over a drying cylinder.

BRUSH COLOURS WITH MOWILITH D32:

500 grams	Mowilith D32
300 grams	Kronos titanium dioxide 1:1
200 grams	water
1kg	

After applying the colour by means of a brush, the nets are dried in the open air or in the hanging room, then they are heated a second time on a drying cylinder as described above.

The white coating should remain pliable at temperatures as low as -40°C and should not splinter off; furthermore, it should adhere and remain unaffected by weather, e.g. by sun, rain, snow and frost. A careful printing of both white colours, mentioned above, yield white coatings meeting these requirements.

In order to obtain a blue tint, the white pigments may be blued with

Indanthren Blue RPZ fine powder, especially pure
Indanthren Blue GPZ fine powder, especially pure

By applying a water repellent finish—by means of Persistol NO or Persistol ground B and Persistolsalz concentrated—a more durable fabric is obtained. Either the paper threads may be impregnated with said agents, the impregnated fabric then being printed, or the printed goods may be treated with Persistol.

White Nets from Hemp Yarn or Jute Yarn for the Camouflage of Horses

Suitably these articles are brushed, the fibrous yarns badly absorbing colour in the spray printing process.

BRUSH COLOUR WITH: MATTWEIB W:

	1	2
Mattweib W	300	500 grams
water	170	170 grams
Lithopone Silbersiegel WIR 1:1	200	— grams
Colloresin DKL 40:1000	300	300 grams
oxalic acid 1:4	30	30 grams
	1kg	

When no pigment is available, printing colour No. 2 is used, Mattweib W already containing enough pigment. Colloresin DKL may be replaced by locust bean flour, Cellapret dry, tragacanth, or Colloresin KB.

The dried nets are fixed by being passed over a drying cylinder.

Coloured Camouflage Nets of Paper Thread

The paper threads are woven after a treatment with Persistol NO, which makes them water-repellent. The nets are mainly provided with dark green and dark brown patterns by means of spray or brush printing. A wet aftertreatment of the nets is not recommended.

Pigment colours with Appretan A, EM, EMW, eggalbumen or with Serikose LCK extra are printed:

1. Examples for spray printing colours with Appretan EMW

Dark Green	Dark Brown	
400 grams	375 grams	Cellapret thickening 1:9
70 grams	— gram	Pigmentgreen B paste
30 grams	30 grams	Pigmentblack paste for printing
— gram	50 grams	Permanent brown FG extra powder
200-300 grams	200 grams	Appretan EMW
200-300 grams	345 grams	water
1kg	1kg	

The prints are dried in the open air, aged for 10 minutes, or only dried at 60°C for a longer time. Instead of ageing them, they may be heated at 100°C up to 10 minutes. A good fixation and fastness to crocking are obtained by storing the batched nets at 80-85°C for eight days.

2. Examples for spray printing colours with Serikose LCK extra

Dark Green	Dark Brown	
150 grams	— gram	Pigmentgreen B paste
20 grams	50 gram	Pigmentblack paste for printing
— gram	50 grams	Permanent brown FG extra powder
480 grams	550 grams	Serikosol NK/alcohol denat 1:1
350 grams	350 grams	solution of Serikose

Solution of Serikose:

110 grams	Serikose LCK extra
890 grams	Serikose NK/alcohol denat 1:1
1kg	

The Serikose printings are only dried.

Water-repellent and inflammable finish:

The nets have to be unaffected by weather and have a low degree of inflammability. The finish is applied in two baths with intermediate drying:

1st bath:	150	grams ammonium chloride, cryst.	)	
	100	grams urea	)	per litre
	37.5	grams Ramasit WDS double concentrated	)	

immersing at 40°C, allowing to drain, and drying at temperatures up to 70°C.

Then the goods are treated in the same manner in the 2nd bath with acetate of alumina (6°Bé) and dried. This finish is rainproof only to a limited degree.



Spun Glass Netting

This is a spun glass netting developed for use as a camouflage net on coastal guns. It was resistant to mildew and rotting and also to seawater. Another advantage was that it would be unaffected by the heat if it came in contact with gun barrels during firing.

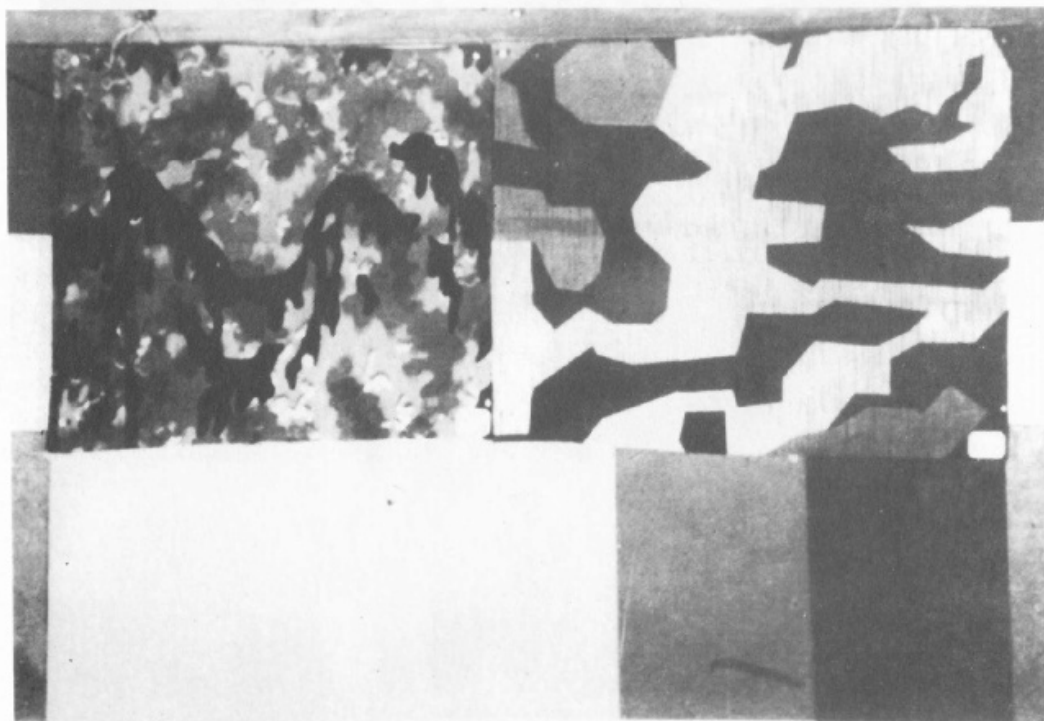
The colouring of this item was quite simple. The netting was padded with an emulsion of poly vinyl acetate containing pigmentgreen B and dried in a loop drier.

The glass fibre seemed to be of poor quality as it splintered badly. Workers were paid a premium to handle it.

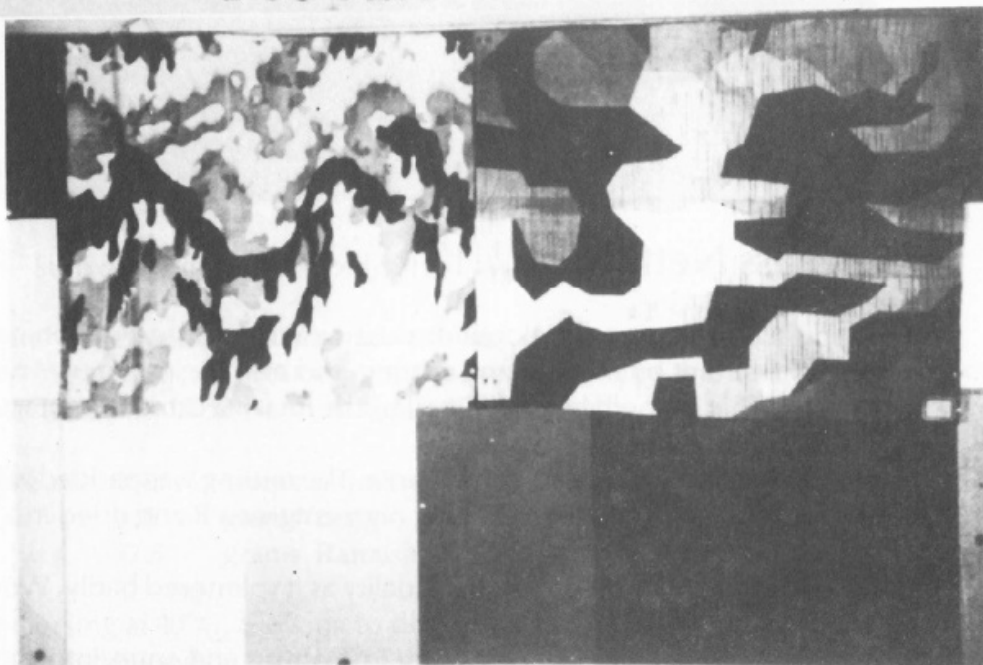
It was made by the Schuller Company in Coburg and spun into yarn by Markel & Kienlin in Esslingen. Believed to have been woven by makers of asbestos fabrics.

PHOTOGRAPHS ILLUSTRATING INFRA-RED SENSITIVITY

The following set of photographs were made to show the difference where camouflaged fabrics were photographed through a normal lens and through infra-red filters. The set of plain coloured oblongs at the bottom of each picture are papers shaded from white to black for comparison purposes. The effectiveness of the use of Indanthren Printing Olive GW (referred to as Tarnolive) is strikingly shown in these pictures. Also of Aniline Black, which was found to be the best black for this purpose.



Isopan



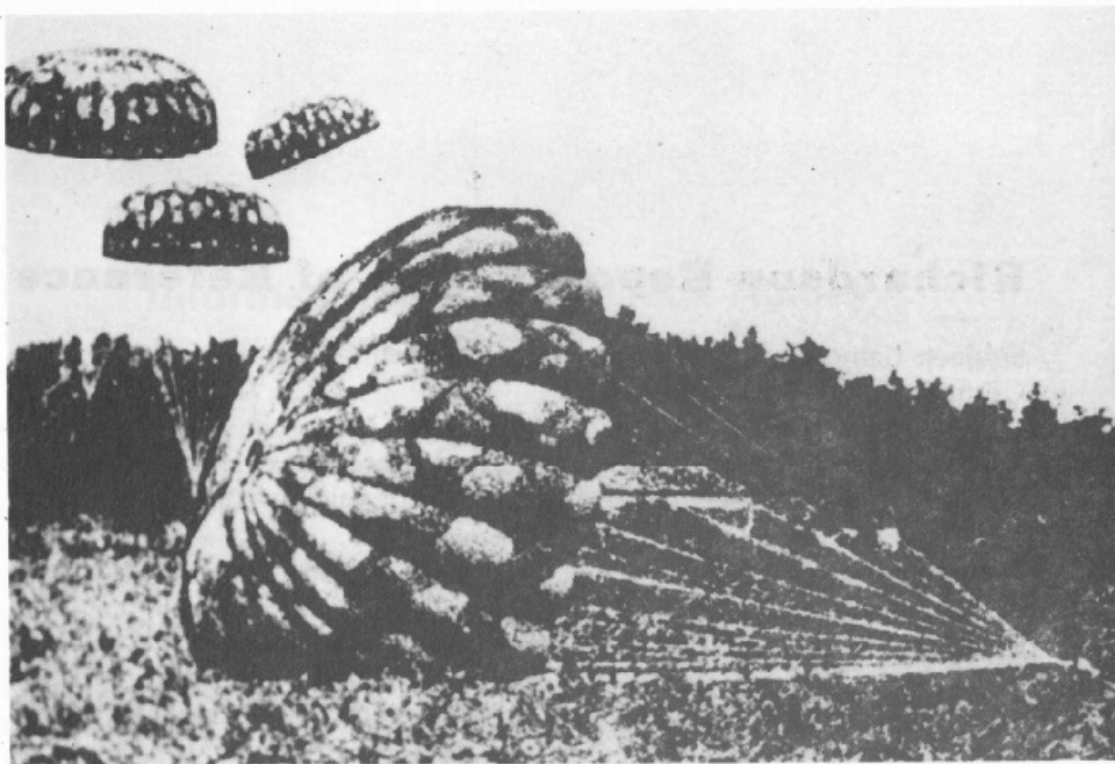
1

2

3

4

Infrared 850 m m



COMMENTS AND RECOMMENDATIONS

That the Germans made extensive use of camouflage fabrics is evident. Whether the results justified the effort is difficult to determine. Obviously white effects against the snow must have had some merit. The other types of effects are to be questioned. Talks with U.S. Army combat officers would seem to bear out the fact that camouflage does not help if the object is in motion, be it a tank or a man. Objects which are stationary can be camouflaged and be very deceptive. In this regard several of these officers felt that the printed German shelter half had merit, which would therefore suggest further study on this particular point.

The amount of work involved in producing the printed and finished fabric was considerable. Some concerns with limited facilities were forced to run the goods through the print machines three times. Also the application of the water repellent materials was a lengthy one but apparently produced good results.

Some quantities of the various brands of Persistols are being obtained and it is recommended that they be tried out and evaluated. Particular attention should be given to Persistol VS which is their latest development. They claim it considerably *increases abrasion resistance*.

Richardson Report Terms of Reference

Subject: Camouflage Fabrics both plain and printed for military use by the German SS and German Army.

Object of Investigation: To investigate German camouflage fabrics and obtain samples, processes, tests and other information pertaining to their production.

Personnel Interviewed:

Mr Franz Nestleberger	—I.G. Farben at Hoechst, in charge of research and development in the application of colour to fabrics, both dyeing and printing.
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Mr. Curt Scheffler	—Director
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Mr. Wilhelm Mauch	—Director
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Mr. F. Lewisch	—Colorist (Superintendent)
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at Wuerttembergische Cattunmanufactur in Heidenheim.

Mr. Martini	—Director Martini & Co., Augsburg
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Mr. Fritz Piepenburg	—Director
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Mr. Hans Engelmann	—Director
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Mr. Franz Fohrmann	—Director
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at Neue Augsburger Kattunfabrik in Augsburg.

General: Information obtained showed that the following items were printed with camouflage patterns: Nylon Parachutes, Shelter Halves, Field Jackets, Paratroopers Suits, Gloves, Gas Mask cloth and sundry other items. There were also several plain coloured items, namely Field Jackets, Paper, Hemp, and Spun Glass Netting.

Information regarding Trade Names used in Preceding Formulae

Biolase N18—Powder	— Bacterial enzymes
Biolase C—Liquid	— Bacterial enzymes
Nekal EX	— Sodium alkyl naphthalenesulfonate
Vivaler E	— Pancreatic enzyme
Igepon T	— Detergent
Igepal	— Polymerized ethylene oxide condensation product. A detergent.
Cellapret	— Carboxymethylcellulose
Colloresin KB	— Same as Cellapret—but wartime product, less pure
Colloresin—DKL	— Oxymethyl cellulose—water soluble but precipitates at temperatures above 60°C
Glycinal HG or HD2	— Glycerine substitutes made up of Glyzine A, Urea and water
Rongalite C	— Sodium hydrosulphite formaldehyde
Persistol Base B	— Waxemulsion
Persistol Salt Conc	— Zirconium Oxichloride
Anthrasol Dyes	— Same as Algosols or Indigosols
Dissolving Salt CN	— Sodium salt of Sulphonate Butylphenol
Ramasit WDS	— Paraffin emulsion containing aluminium acetate
Serikose NK & LCK	— Cellulose acetates
Appretan EMW	— Emulsified resin
Silbersiegel (Silverseal)	— Zinc Oxide
Silbersiegel WD	— Water Dispersible Zinc Oxide
Mowilith D32	— Poly Vinyl Acetate emulsion, containing 50% of solids. Plasticized with 3% Tricresol Phosphate and 2% of Dibutyl Pthalate
Mattweiss W	— 50% Mowilith D32, 25% Titanium Dioxide plus additional Dibutyl Pthalate and a small amount of a catene active softener

£5.95.
(UK only)

