CIRCTEX: Washing of recycled polyester fabrics

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Content

1 Objectives of the tests

The main objectives of the testing plan were:

- to assess the new fabric performance at original state and after series of washing cycles
- to determine the best washing process to maintain the garments.
- to compare the performance of the fabrics made with virgin fibres or with recycled material.

2 Testing plan

2.1 Norms and testing methods

The drivers for the testing were the following norms:

- EN343 Protective clothing - Protection against rain: This standard has different classes and is used to certify garments when they protect against the rain. These types of garments are used by workers that work for longer times outside in bad weather conditions e.g. are construction workers, airport ground crew, postman's, traffic police… For this research the test standards and conditions to test the water penetration resistance, water vapor resistance, tensile strength, seam strength and dimensional stability are interesting parameters linked to washing.
- EN-ISO 20471 High visibility clothing - Test methods and requirements. This standard is used to assure the visibility of the wearer during work. This type of garments is used where there is possible danger if people are not seen in the environment. It covers daylight (fluo) and darkness (reflective parts). For this research the test standards and conditions to test the colour change under the influence of several parameters are interesting parameters linked to washing.
- EN-ISO 13688 Protective clothing - General requirements. This standard sets general requirements for all PPE garments and is used within the previous 2 standards.

The main properties that were evaluated are the following:

- Water penetration – body and seams
- Water vapor resistance (breathability)
- Physical properties such as strength, abrasion, pilling
- Colourfastness
- Appearance after washing (up to 100 cycles)

A detailed list of tests and norms is shown in the table below.

CIRCTEX - TESTING PLAN - HV ORANGE 3 LAYERS		
HOME LAUNDERING 40°C + 60°C + 90°C (line dry + tumble dry 1 and 2 dots)		
		Tested on
EN ISO 13688:2013		
pH	EN ISO 3071	fab
arylamines HPLC	EN 14362-1	fab
EN 343:2019		
Water penetration - body	EN 20811:1992	fab
Water penetration - seams	EN 20811:1992	Mock-up or gmt
Water vapour resistance - body	EN ISO 11092:2014	fab
Tensile strength	EN ISO 1421:2016	fab
Tear resistance	EN ISO 4674-1:2016	fab
Seam strength	EN ISO 13935-2:2014	Mock-up or gmt
Dimensional stability	ISO 6330 (note: CL = 4N, tumble dry (F))	fab
EN ISO 20471:2013		
Colour coordinates	EN ISO 20471:2013 - par 5.1, 5.2, 7.2, 7.5	
Original		fab
After lightfastness	ISO 105-B02:1994	fab
After washing	ISO 6330 (note: CL = 4N, tumble dry (F))	fab
Colourfastness to		
- washing	ISO 105-C06 (domestic and industrial wash)	fab
- dry cleaning	ISO 105-D01	fab
- perspiration	ISO 105-E04	fab
- hypochlorite bleaching	ISO 105-N01	fab
- hot pressing	ISO 105-X11	fab
- dry rubbing	ISO 105-X12	fab
Other properties		
Weight	ISO 3801-5	fab
Delamination	ISO 2411 (22017)	fab
Appearance after wash	ISO 15487 (2018)	Mock-up or gmt
Abrasion	ISO 12947-2	fab
Pilling	ISO 12945-2	fab
Stain removal	Type of stains + testing protocol to be defined/confirmed	fab
TEST 2 LAYERS ORANGE HV with correct PES tape		
Water penetration - seams	EN 20811:1992	Mock-up or gmt
Appearance after wash	ISO 15487 (2018)	Mock-up or gmt

2.2 Testing at different stages

These workwear/PPE garments are meant to be durable and should stand multiple washes without losing their key properties.

We therefore planned to test the products in original condition, after 5 washes (minimum to consider certification), after 50 washes and after 100 washing cycles.

The table below is an extract from the testing plan and shows how different tests are spread.

LAB TESTING	ORIGINAL			5 X WASH 40°C + LD			50 X WASH 40°C + LD			100 X WASH 40°C + LD		
	Fabric	Mock-up	garment	Fabric	Mock-up	garment	Fabric	Mock-up	garment	Fabric	Mock-up	garment
EN ISO 13688:2013												
pH	X											
arylamines HPLC	X											
EN 343:2019												
Water penetration - body	X			X			X			X		
Water penetration - seams		X			X			X			X	
Water vapour resistance - body	X			X			X			X		
Tensile strength	X			X			X			X		
Tear resistance	X			X			X			X		
Seam strength		X			X			X			X	
Dimensional stability	X			X								
EN ISO 20471:2013												
Colour coordinates												
Original	X											
After lightfastness	X											
After washing				X			X					
Colourfastness to												
- washing	X											
- dry cleaning	X											
- perspiration	X											
- hypochlorite bleaching	X											
- hot pressing	X											
- dry rubbing	X											
Other properties												
Weight	X			X			X			X		
Delamination	X											
Appearance after wash					X	X		X	X		X	X
Abrasion	X											
Pilling	X											
Stain removal	X			X			X					

Initial more washing tests were foreseen but due to time reasons we needed to limit the tests.

2.3 Home-laundering and industrial washing

The objectives of the research were to determine what washing method is recommended to ensure a higher durability.

Two obvious options to consider were the home-laundering that was mostly used during the wear trials, and the industrial washing that could be the only possibility in some B2B contracts (e.g., leasing).

In washing 4 parameters are of importance, time, temperature, mechanical action, and chemicals (washing detergents). This is expressed by the circle of sinner. All 4 parameters need to be balanced out to have a good washing performance. If you change one parameter, the others must be adapted as well.

Comparison between home and domestic laundry:

Home laundry is considered to have a lower mechanical action than industrial laundering. For home wash it depends on the washing machine, mainly older machines have a bigger water ratio than newer machines. Also, the loading capacity can differ a lot between the different domestic machines but is not comparable with the bigger industrial washing machines. The load of an industrial washing machine is much higher, thus also the mechanical action. In industrial washing the load in a washing machine will be lowered and the textile water ratio increased when delicate fabrics are washed.

Over the years both industrial and domestic washing processes evolved to less water usage. In industrial laundering some equipment reuses water of the previous batch (tunnel washing). But in general, if you would compare industrial washing it has a lesser textile / water ratio than domestic washing, even without the reuse of water in a tunnel washing machine.

For industrial laundry the temperature was lowered over the years to safe energy costs. This means to have the same washing effect more chemicals are used (circle of Sinner). In domestic laundering temperatures didn't change and the consumer determines the amount of chemicals used.

The average time is lower with industrial washing than with domestic washing.

In domestic laundering there is only spinning to remover water and then tumble drying at different temperature settings. This differs from industrial laundering where the laundry can be pressed (normally not done for clothing) or spined to remove the water. Than there is tumble drying at different temperatures and tunnel drying. The air in tunnel drying has a higher temperature (around 120°C to 170°C) then in tumble drying (around 70°C to 90°C).

On of the big difference between industrial and domestic laundering is the consumers behaviour. A study of Ginetex[1] has shown that although 70% follows the care label instructions in the garment, 62% cuts out the label. This leads to mistreatment of the garment because they didn't take the care instructions into account (30%) or they might have forgotten them because the label was removed (62%). When the label is removed this also causes an issue for the industrial laundering companies. This problem is none existing if the laundering is done withing bigger contracts with companies and certainly not in the case of leasing. The industrial laundering company will adapt the program according to the items to be washed. They will also reapply certain finishings if needed e.g., water repellent or fire retardant finishings if needed. This can lead to a longer lifetime of the garment. In general, it is to be expected that an industrial laundering process is more efficient and environmentally friendly.

Comparison between real life washing and lab testing:

In real life many parameters might vary, e.g. detergents and additives used, equipment used (setting possibilities and size), time, used amount of chemicals, amount of water used, type of water used (e.g. amount of minerals, chlorine present).

To have comparable results between different labs the parameters that can be changed are very limited in a lab environment. Certainly, when the washing is performed according to the official test standards. The size of the drum, volume of water, used detergent, the choice of temperature settings, the speed of the drum, water to be used… are predetermined in the standard.

For this reason, the real-life washing results can differ from the results in a lab environment.

[1] A BAROMETER FOR TEXTILE CARE LABELLING IN EUROPE, https://www.ginetex.net/article/GB/a-barometer-for-textile-care-labelling-in-europe , 2016, Ginitex

In the case of the study the following washing standards are used:

- EN ISO 15797 : 2018 "Textiles - Industrial washing and finishing procedures for testing of workwear"
- EN ISO 6330 : 2021 "Textiles - Domestic washing and drying procedures for textile testing"

Comparison between home and domestic laundry tests:

The following settings were used:

For home-laundering (tested in Wascator)

- Washing temperature: 40°C
- Line drying and tumble drying

For industrial washing

- Washing temperature: 40°C
- Tumble drying

3 Material used for testing.

For the different tests, fabrics from the original trials and fabrics made with the chemically recycled polyester were used.

Depending on the objectives of the tests, different versions of the fabrics were considered:

- 2-layer fabric = woven fabric + membrane (laminated)
- 3-layer fabric = woven fabric + membrane (laminated) + tulle (laminated)

It is to be noted that the original fabrics were only available in their 3-layer version (available stock for testing). A 3-layer version and a 2-layer version of the newly developed fabric were considered in these tests. Depending on the tests, the tulle (the 3rd layer) appears not to have a true impact on the performance of the fabrics.

IBQ Fabrics, who delivers the fabrics used for these tests, mentioned that the black and HV fabrics bases only differ by the colour. Depending on the choices made, a different water repellent finish and a different membrane can be applied to one base fabric. And a tulle fabric can be added (lamination) or not. The assumption is therefore that the black and HV fabrics are similar for physical properties such as strength, shrinkage, etc.

3.1 Fabrics from original projects wear tests

From the Centexbel registration form (order A2204218)

T2215737 – 3L JACKET BLACK CO-POLYESTER MEMBRANE

T2215738 – 3L JACKET ORANGE HV ALTERNATIVE MEMBRANE

Made with polyester from recycled PET bottles and recycled production waste.

3.2 Fabrics from new developments

2L JACKET BLACK ALTERNATIVE MEMBRANE (PT4453-2L BK)

2L JACKET ORANGE HV CO-PES MEMBRANE (PT4435-2L HV)

3L JACKET BLACK ALTERNATIVE MEMBRANE + RY PES TUL (PT4453-3L BK)

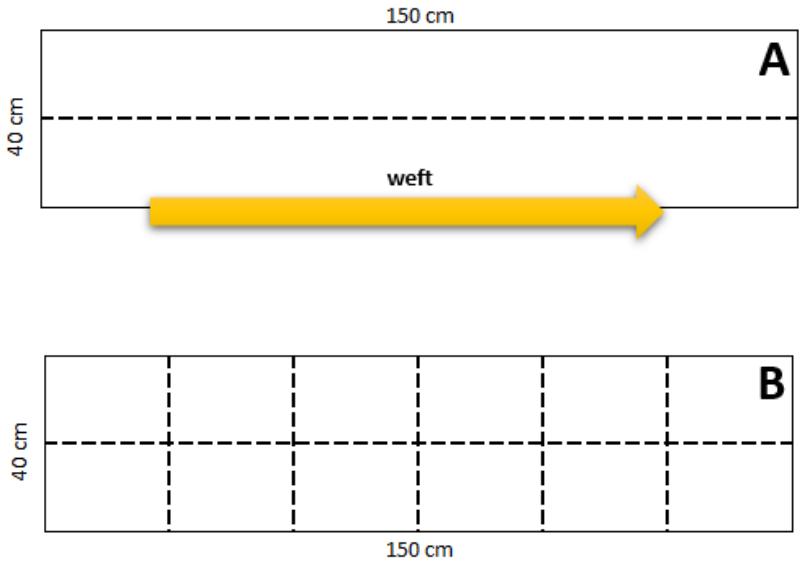
3L JACKET ORANGE HV CO-PES MEMBRANE + RY PES TUL (PT4453-3L HV)

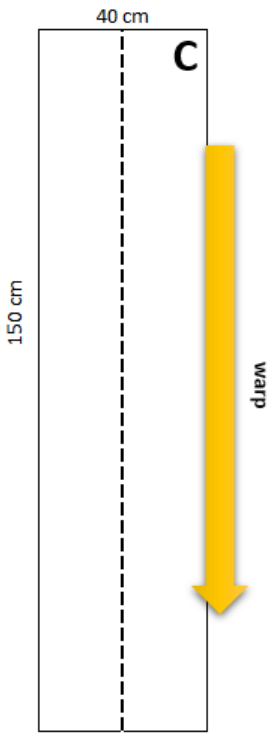
Made with chemically recycled polyester

3.3 Mock-ups

One part of the tests must be carried out on seams. Mock-ups were prepared based on requirements highlighted by the laboratories in order not to have to use jackets.

Three different types were requested to optimize the use of fabric.





The following quality guidelines applied for the manufacturing of the mock-ups:

- The seams are real seams. The fabric pieces are first cut, then sewn together and taped.
- Same lining as on the final garments used to cover the back of the mock-ups. The lining will be attached to the mock-ups by an overlock seam (or similar) all around the edges.
- SPI (Stitches Per Inch): should be consistent and as specified for the final products.

- Taping: same tape and same application conditions (temperature, pressure, etc) as in production.
- All mock-ups should be made at the same time, and on the same equipment to ensure a good level of consistency.

3.4 Jackets

Half jackets with a simplified design (no zips, some accessories not attached) were also necessary to be able to assess the appearance of garments after washing.

The use of half garments (1 sleeve + ½ body) with the reflective strips sewn on was meant to reduce the work at manufacturing and also to reduce the load for the washing, especially for the home laundering.

4 Seam tapes

All parameters that take seam tapes into consideration were not taken into consideration, such as the water penetration resistance. Some tests reports that came too late to be included in this report will be made available for review.

5 Test reports

All tests described in this report were carried out in laboratories from Centexbel, mainly in the physical and chemical lab that is accredited according to EN ISO/IEC 17025.

https://www.centexbel.be/en/testing/accredited-testlab

6 Test results – key take-out's

A short summary of the results of the tests (physicals + water penetration + WVR) is provided in the table at the bottom of this report (Summary test results F44, F45, F78 (Table 1)).

6.1 Analysis of the results

The different washing options are referred to as follows in this report:

- HL = Home Laundering
- TD = Tumble Drying
- LD = Line Drying
- IW = Industrial Washing

Abbreviations are also used to refer to the following tests:

- WP = water penetration
- WVR = water vapor resistance

6.2 Washing

The testing of the different fabrics required a series of washing cycles, either home-laundering or industrial. There were washed and then dried and this 5, 50 and 100 times after which assessment and test were performed. This The washed samples are referred to in the test reports at the end are:

- T2309444 3L JACKET BLACK ALTERNATIVE MEMBRANE + RY PES TUL
- T2309445 3L JACKET ORANGE HV CO-PES MEMBRANE + RY PES TUL
- T2309778 3L JACKET ORANGE HV CO-PES MEMBRANE + RY PES TUL (chemical recycled)

6.3 Fabric 3L Jacket Black + Alternative membrane membrane + PES Tulle (T2309444)

Types of washing cycles

- HL+LD and HL+TD
- IW+TD

6.3.1 Unwashed/original state

- All colour-fastness tests and strength parameters OK
- WP >= 1.000 mbar
- WVR very high (43.72 m^2.Pa/W): the fabric is not breathable before washing

6.3.2 After 5 washing cycles

- WP 40% lower on HL+LD and 25% on IW+TD, remains on maximum with HL+TD
- Much lower WVR in all 3 options: almost 3 times less, meaning the product becomes more breathable.

6.3.3 After 50 washing cycles

- WP increases on HL+LD, decreases by 40% on HL+TD and collapses on IW+TD (no more WP)
- On IW+TD, both the warp and weft tear drop (35 to 60% reduction)
- On HL+TD, tulle delaminated and sample completely wet.

6.3.4 After 100 washing cycles

- The IW+TD is not suitable anymore due to a further drop in performance for all key parameters
- The tulle has been removed in the wash
- The HL+TD is still viable and still offers a good WP

6.4 Fabric 3L Jacket HV + CO-PES membrane + PES Tulle (T2309445)

Types of washing modes

- HL+LD and HL+TD
- IW+TD

6.4.1 Unwashed/original state

- All colour-fastness tests and strength parameters OK
- WP >= 1.000 mbar
- WVR rather high (25.08 m^2.Pa/W), with a poor breathability

6.4.2 After 5 washing cycles

- WP gets lower on HL+LD (759 mbar) and on IW+TD (888 mbar), remains on maximum (>= 1000 mbar) with HL+TD
- Much lower WVR in all 3 options: between 25% and 45% reduction, meaning the product becomes more breathable

6.4.3 After 50 washing cycles

- WP decreases further on HL+LD (474 mbar) and HL+TD (273 mbar), and collapses on IW+TD (0 mbar)
- On IW+TD, both the warp and weft tear drop significantly (20 to 55% reduction). The tulle layer came off (lower weight)

6.4.4 After 100 washing cycles

- The HL+LD offers the best protection against water (837 mbar). The HL+TD has a WP of 189 mbar
- The IW+TD was not washed further than 50 cycles given the damages to the membrane and the tulle layer

6.5 3L Jacket HV + CO-PES membrane + PES Tulle (T2309778)

Types of washing modes

- HL+TD - Due to lower quantities available for the tests, LD option not tested
- IW+TD

6.5.1 Unwashed/original state

- All colour-fastness tests and strength parameters OK
- WP >= 1.000 mbar

- WVR lower than on other fabrics (11.46 m^2.Pa/W), with a rather good breathability

6.5.2 After 5 washing cycles

- 10% decrease in the warp tear
- WP remains >= 1000 mbar for both the HL+TD and IW+TD options

6.5.3 After 50 washing cycles

- After HL+TD, the WP goes down to 711 mbar, with the other parameters remaining stable
- The IW+TD is damaging the fabric, leading to a major drop in tear and the removal of the tulle WP collapses to 0 mbar as a consequence

6.5.4 After 100 washing cycles

- The HL+TD option still delivers some WP (328 mbar) and has only a minor impact on the other parameters.

6.6 Comparison between the 3 fabrics

For convenience, in this section, the 3 fabrics will be referred to by the last 2 digits of their registration code: F44, F45 and F78.

6.6.1 Unwashed/original state

- All 3 fabrics have a similar weight
- On F78, warp tensile 15% higher and 34% on weft tensile than on the other fabrics
- Weft tear almost 30% lower on F45 and F78, the 2 HV fabrics, vs. F44
- Similar performance for water penetration on all 3 fabrics
- Significant differences in WVR: range from 43,72 m^2.Pa/W (much less breathable) to 11.46 m^2.Pa/W (more breathable)

6.6.2 After 5 washing cycles

- F78 is the only fabric that maintains a WP >= 1.000 mbar also in IW
- Even though it is not an issue, F78 is the fabric with the highest lowering of the warp tear (10%)

6.6.3 After 50 washing cycles

- The most important point is that all 3 fabrics do not stand 50 IW+TD

6.6.4 After 100 washing cycles

After 100 washing cycles, the HL+LD on F44 and F45, and the HL+TD on F44, offer the best protection against water penetration and the best breathability.

The F45 and F78 are behind on WP when washed through HL+TD.

7 Stain removal

The test was performed based on ISO26987. The stains were allowed to dry for 2 hours.

Afterwards they were cleaned using a sponge and a variety of solvents. Afterwards, the samples

were evaluated. Any remaining stains were repeated with only drying for 30 minutes. If the stains could still not be fully removed the test was repeated with a different cleaning method. In this test only the stains that could not be removed in the previous order were tested.

Explanation of observation after cleaning:

- 0= not changed/not affected;
- 1= slightly changed;
- 2= moderately changed;
- 3= greatly changed/severe

In the below table the influence of detergent with water can be found

Type of chemical/contaminant	Contact time	Cleaning agent	Observation after cleaning
Gasoline, mineral oil	30 min	water with detergent	0
tar (bitumen)	30 min	water with detergent	3
vegetable oil	2 h	water with detergent	0
shoe polish	30 min	water with detergent	1
ketchup	2 h	water with detergent	0
mud	2 h	water with detergent	0
paint	30 min	water with detergent	3
building dust (gyproc	2 h	water with detergent	0
rust	2 h	water with detergent	0

The tables below show the results of the test that were preformed to remove the stains that were in effectively removes with detergent with water:

Results of the test (cleaning with aceton)

Product	Time	Score
shoe polish	30 minutes	1
vegetable oil	2 hours	0
paint	30 minutes	1
bitumen	30 minutes	3

Results of the test (cleaning with methanol)

Product	Time	Score
shoe polish	30 minutes	2
paint	30 minutes	3
bitumen	30 minutes	3

Results of the test (cleaning with petroleumether)

Product	Time	Score
shoe polish	30 minutes	1
paint	30 minutes	2
bitumen	30 minutes	1

Results of the test (cleaning with tetrahydrofuran)

Product	Time	Score
shoe polish	30 minutes	1
paint	30 minutes	2
bitumen	30 minutes	2

Results of the test (cleaning with toluene)

Product	Time	Score
shoe polish	30 minutes	2
paint	30 minutes	1
bitumen	30 minutes	0

8 Recommendations

Important disclaimer: the following recommendations do not take the tape and seams into consideration. The mock-ups were not available for these tests. The following recommendations correspond therefore to the best-case scenario (plain fabric).

The chemically recycled polyester material is used does not make a significant difference. Eventually, the elements causing the issues are first of all the tulle layer (comes off through industrial wash) and the membrane that loses its performance once damaged.

The key take-out is that these fabrics are not suitable for the industrial washing with tumble drying, at least if to be washed up to 50 times.

There is no clear line between the HL+LD and the HL+TD for the water penetration. The TD could be an interesting option to help maintain the water repellence finish, but there is no obvious impact. The LD helps reducing the mechanical action on the fabrics and on the membrane.

The final recommendation Is therefore to go for 40°C, normal cycle, with tumble drying. The users will finally decide to use TD or LD. The wear test has shown that most users were line drying their clothes!

A new membrane developments and improvements of the accessories could make it industrial washable.

Regarding the stain removal. The stains gasoline, mineral oil, vegetable oil, ketchup, mud, building dust and rust could be removed with a water with detergent solution.

The best cleaning methods with the tested solvents are listed below:

- vegetable oil: fully removed with acetone
- bitumen: fully removed with toluene
- paint: partly removed with acetone and toluene
- 4) shoe polish: partly removed with acetone, petroleum ether and tetrahydrofuran

Summary test results F44, F45, F78 (Table 1)

N°	Date Report	Report #	Fabrics	Wahing	Main tests	# washes/other	Warp tensile N	Weft tensile N	Warp tear N	Weft tear N	WP mbar	WVR m².Pa/W	Weight g/m²	
1	03/07/2023	**40**	**T2309444**	**ORIGINAL**	Physicals, chemicals, CF, etc	ORIGINAL	1213	973	130	100	1000	43,72	264	T2309444
2	30/06/2023	**33**	**T2309444**	**04d**	Staining, tear, tensile, weight, WP, WVR	5 x HL 40 + LD	1193	991	130	94	610	12,7	272	T2309444
3	22/06/2023	**20**	**T2309444**	**01d**	Staining, tear, tensile, weight, WP, WVR	5 x HL 40 + TD	1204	992	130	100	1000	16,5	270	T2309444
4	22/06/2023	**22**	**T2309444**	**07d**	Staining, tear, tensile, weight, WP, WVR	5 x IW 40 + TD	1130	914	120	99	751	12,5	269	T2309444
5	30/06/2023	**34**	**T2309444**	**05d**	Staining, tear, tensile, weight, WP, WVR	50 x HL 40 + LD	1174	966	110	94	1000	8,5	274	T2309444
6	29/06/2023	**26**	**T2309444**	**02d**	Staining, tear, tensile, weight, WP, WVR	50 x HL 40 + TD	1166	965	100	100	602	13,9	274	T2309444
7	29/06/2023	**27**	**T2309444**	**08d**	Staining, tear, tensile, weight, WP, WVR	50 x IW 40 + TD	854	738	54	65	0,5	3,87	269	T2309444
8	30/06/2023	**35**	**T2309444**	**06d**	Staining, tear, tensile, weight, WP, WVR	100 x HL 40 + LD	1107	923	110	110	933	8,6	274	T2309444
9	03/07/2023	**41**	**T2309444**	**03d**	Staining, tear, tensile, weight, WP, WVR	100 x HL 40 + TD	1083	914	91	110	928	9,28	277	T2309444
10	03/07/2023	**42**	**T2309444**	**09d**	Staining, tear, tensile, weight, WP, WVR	100 x IW 40 + TD	537	476	27	33	0	3,52	208	T2309444
11	03/07/2023	**43**	**T2309445**	**ORIGINAL**	Physicals, chemicals, CF, etc	ORIGINAL	1221	970	94	100	1000	25,08	253	T2309445
12	30/06/2023	**37**	**T2309445**	**04d**	Staining, tear, tensile, weight, WP, WVR	5 x HL 40 + LD	1200	977	87	110	759	13,5	261	T2309445
13	22/06/2023	**21**	**T2309445**	**01d**	Staining, tear, tensile, weight, WP, WVR	5 x HL 40 + TD	1217	978	89	100	1000	18,4	260	T2309445
14	30/06/2023	**39**	**T2309445**	**07d**	Staining, tear, tensile, weight, WP, WVR, staining	5 x IW 40 + TD	1068	895	87	100	888	15,27	262	T2309445
15	03/07/2023	**44**	**T2309445**	**05d**	Staining, tear, tensile, weight, WP, WVR	50 x HL 40 + LD	1155	968	84	96	474	7,97	264	T2309445
16	30/06/2023	**36**	**T2309445**	**02d**	Staining, tear, tensile, weight, WP, WVR, staining	50 x HL 40 + TD	1146	960	83	100	273	9,05	266	T2309445
17	29/06/2023	**29**	**T2309445**	**08d**	Staining, tear, tensile, weight, WP, WVR	50 x IW 40 + TD	883	796	45	46	0	2,32	174	T2309445
18	30/06/2023	**38**	**T2309445**	**06d**	Staining, tear, tensile, weight, WP, WVR	100 x HL 40 + LD	1099	934	78	89	837	7,2	267	T2309445
19	29/06/2023	**28**	**T2309445**	**03d**	Staining, tear, tensile, weight, WP, WVR	100 x HL 40 + TD	1096	927	89	91	189	9,89	267	T2309445
20	03/07/2023	**45**	**T2309778**	**ORIGINAL**	Physicals, chemicals, CF, etc	ORIGINAL	1404	1302	92	100	1000	11,46	261	T2309778
21	22/06/2023	**24**	**T2309778**	**01d**	Staining, tear, tensile, weight, WP, WVR	5 x HL 40 + TD	1394	1293	83	100	1000	7,5	265	T2309778
22	29/06/2023	**25**	**T2309778**	**07d**	Staining, tear, tensile, weight, WP, WVR	5 x IW 40 + TD	1266	1232	84	100	1000	6,1	261	T2309778
23	29/06/2023	**30**	**T2309778**	**02d**	Staining, tear, tensile, weight, WP, WVR	50 x HL 40 + TD	1362	1287	88	110	711	6,23	268	T2309778
24	29/06/2023	**32**	**T2309778**	**08d**	Staining, tear, tensile, weight, WP, WVR	50 x IW 40 + TD	1114	1097	51	54	0	2,39	173	T2309778
25	29/06/2023	**31**	**T2309778**	**03d**	Staining, tear, tensile, weight, WP, WVR	100 x HL 40 + TD	1333	1264	98	110	328	6,25	267	T2309778

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