James Heal

AquAbrasion

ASSESSING THE TRUE IMPACT OF THE OUTDOORS ON OUTDOOR WEAR

CONTENTS

TESTING & RESULTS

CONCLUSION

IDENTIFYING A PROBLEM

We were approached by a leading outdoor wear manufacturer with a testing issue – how to accurately replicate the conditions their garments were put through in the real world?

Standard tests on outdoor rainwear such as walking jackets and cagoules would include abrasion in dry conditions, but this didn't take into account the wet conditions these garments were designed to be worn in.

This led us to ask the question:

If a garment claiming to be waterproof will be worn in wet conditions, why don't we test in these wet conditions as well?

FINDING A SOLUTION

To solve this issue we created AquAbrasion Wet Abrasion Tester.

The AquAbrasion is a Wet Abrasion Tester based on the traditional Martindale instrument. It uses a controlled pump system to dose fabric specimens with liquid which keeps the specimen wet for the duration of the test. Drains are recessed into the main table to prevent overspill when conducting testing.

Deionised water can be used to replicate rain, or a perspiration solution, can be used to replicate sweat.

The AquAbrasion is an accurate and repeatable way of conducting wet abrasion testing, which we have proven to be a crucial and often detrimental step in establishing the durability of outdoor wear.

We have proven, through a series of in depth tests, that to make an accurate claim about the performance of an outdoor garment it must first be subject to wet abrasion to truly understand the impact of outdoor wear and tear.

THE PREMISE OF OUR TEST

We estimated the average person has a stride length of approximately 2.1 to 2.5 feet. This means it takes approximately 2,000 steps to walk one mile, and 10,000 steps to walk 5 miles. If one stride equals one rub on the Martindale, then 100,000 rubs would equate to 50 miles of walking.

We initially tested 5 different fabrics in both wet and dry conditions to 100,000 rubs, using a modified version of the ISO 12947 abrasion method. The fabric was abraded against itself to replicate real life situations, such as a sleeve rubbing against the body of a garment by the wearer.

All the fabrics chosen for this test are typically found as the outer shell in outdoor rainwear.

- Fabric 1: 2oz PU Nylon
- Fabric 2: Water Resistant Tactel
- Fabric 3: Waterproof Breathable Coated Microfibre
- Fabric 4: PX300 Laminated Breathable Polyester
- Fabric 5: 3 Layer Fabric with ePTFE membrane

The fabric was dosed at 1ml per minute with deionised water to replicate rainy wet conditions.

Following the abrasion testing, we tested for shade change, tensile strength, burst strength, oil repellency and resistance to surface wetting to get a comprehensive view of the impact of wet abrasion on the garment.

SHADE CHANGE

"The results illustrate that wet testing proves to create the greater amount of shade change, which is considered to be detrimental to the aesthetics of the fabric"

For the purpose of these trials, the shade change was assessed at the end of the test after 100,000 rubs.

Grading was conducted using a Spectrophotometer.

Shade change is determined using a grey scale ranging from 1 to 5.
1 indicates the greater change in shade after testing when compared to the original untested fabric, and 5 indicates no change in shade.

Abrasion Shade Change after 100,000 rubs		
140mm Diameter Specimen		
Grade		
Fabric	**Dry**	**Wet**
F1	4/5	4 - 4/5
F2	5	2/3 - 3
F3	3/4 - Brighter	3/4 - Duller
F4	5	4/5
F5	4-5	4-5

Abrasion Shade Change after 100,000 rubs		
38mm Diameter Specimen		
Grade		
Fabric	**Dry**	**Wet**
F1	4	2/3
F2	4/5	2
F3	3 - 3/4	3
F4	4/5	3/4
F5	4/5	3-2/3

On every fabric, shade change increases after wet abrasion. This is a key consideration for garment manufacturers and brands, who need to ensure a lifespan for their outdoor wear as a sign of quality,

TENSILE STRENGTH

"Fabrics subjected to wet conditions with the presence of a self-abradent prove to be weakened more greatly than when subject to the same abrasive stresses in dry conditions."

The ISO 13934-02 Tensile Strength - Grab Method is a tensile test in which the centre part of the specimen width is gripped in the tensile grip jaws. Tensile force is applied to the fabric specimen until rupture and maximum force elongation is recorded. We used the James Heal Titan Universal Testing Machine to conduct this test.

Modification to the test was necessary due to the small specimen size. To accomodate this, jaw separation was reduced to 50mm.

The fabrics were tested in both warp and weft directions in 3 different states; original, tested dry to 10,000 rubs and tested wet to 10,000 rubs.

Warp - Max Force (N)

	Max Force (N)		
	Original	Dry	Wet
F1	1002	791	638
F2	513	476	463
F3	605	542	522
F4	426	334	286
F5	689	689	641

Weft - Max Force (N)

	Elongation at Max Force %		
	Original	**Dry**	**Wet**
F1	812	791	638
F2	523	525	459
F3	228	224	220
F4	342	309	271
F5	714	698	677

Warp - Elongation at Max Force (%)

	Elongation at Max Force %		
	Original	**Dry**	**Wet**
F1	56	49	41
F2	67	62	60
F3	37	35	35
F4	38	28	22
F5	54	51	50

Weft - Elongation at Max Force (%)

	Elongation at Max Force %		
	Original	**Dry**	**Wet**
F1	50	45	38
F2	79	81	71
F3	17	31	19
F4	29	25	22
F5	63.5	60.5	59

All tests for Maximum Force Exertion and all but one test for Elongation at Max Force show that the tear strength of the fabric is significantly weaker when subjected to wet abrasion.

This means that garments which are subjected to difficult conditions where tears could occur, such as walking jackets, are much more likely to tear after being worn in the rain.

BURST TEST

"In every case, the wet abraded fabric is weaker and less robust than fabric tested in dry conditions when subjected to the same abrasion test.

The ISO 13938-2 burst test is a pneumatic pressure method for the determination of bursting strength and bursting distension of textile fabrics. We used the James Heal TruBurst to conduct this test.

The test was conducted with pressure forced from the reverse of the fabric to replicate the most usual and frequent direction of pressure when wearing a garment.

Burst Pressure - kPa

	Burst Pressure - kPa		
	Original	**Dry**	**Wet**
F1	846	820	756
F2	403	404	376
F3	397	390	380
F4	374	325	260
F5	661	657	644

Burst Height - mm

	Height to Burst - mm		
	Original	**Dry**	**Wet**
F1	34	33	31
F2	36	36	35
F3	25	25	24
F4	26	23	21
F5	33	33	33

In every fabric tested, the burst strength and burst distension reduced significantly on the wet abraded fabric.

This shows that the fabric became weaker and so less able to withstand the force of pressure from movements, such as the bend of a knee or elbow, causing the fabric to burst and split.

SPRAY RATE

"All fabrics, without exception, showed to be less resistant to water when previously abraded in a wet state. The durable water repellency on all fabrics had been degraded."

The ISO 4920:2012 Spray Rate Test determines the resistance of fabric to surface wetting water. The spray rating is determined by comparing the appearance of the specimen with descriptive standards and photographs.

Grade 5 - No sticking or wetting of the specimen
Grade 4 - Slight random sticking or wetting of the specimen face
Grade 3 - Wetting of specimen face at spray points
Grade 2 - Partial wetting of the specimen face beyond spray points
Grade 1 - Complete wetting of the entire specimen face beyond the spray points
Grade 0 - Complete wetting of the entire face of the specimen

Fabric Reference	Spray Rate		
	Original	Dry	Wet
F1	5	2	1
F2	5	3/4	0
F3	5	0	0
F4	3	3	1
F5	5	4/5	3/2

The results show that the true impact of abrasion on outdoor rainwear cannot be replicated in dry conditions, as with every fabric tested the resistance to water decreased on the wet specimen.

This impacts the water repellent properties of the fabric, and could also impact other aspects of it's performance. An example of this is breathability - if the outer repellent barrier is worn away, water will soak into the outer fibres of the fabric forming an airtight barrier. This would render the inner membrane ineffectual as water vapour cannot pass through so the fabric looses its ability to breathe.

OIL REPELLENCY

"For all the fabrics that appeared to show oil repellency, wet abrasion would appear to affect the effectiveness of the fabrics ability to repel oil."

Conducting this test sought to establish the presence of fluorochemical type finishes and how both dry & wet abrasion effected the integrity of such finishes.

The test provides an indication of oil stain resistance: The higher the oil repellency grade, the better resistance to staining by oily materials.

"Drops of standard test liquids, consisting of a selected series of hydrocarbons with varying surface tensions, are placed on the fabric surface and observed for wetting, wicking, and contact angle. The oil repellency grade is the highest numbered test liquid which test liquid that does not wet the surface fabric." AATCC 118 Principle

Oil Repellency			
Fabric Ref	Original	Dry	Wet
F1	2B	1D	1D
F2	6B	5B	1D
F3	2B	1D	1D
F4	1D	1D	1D
F5	1C	1C	1D

Green = Pass
Red = Fail

The test results show that those fabrics which showed to have some initial oil repellency, had none once the wet abrasion testing had been conducted. This is particularly noticeable in Fabric 2, the Tactel, which showed to be particularly oil repellent achieving an initial grade of 6. Some repellency was retained after dry abrasion testing, but this fabric failed after wet abrasion.

In all cases, when subjected to wet abrasion, the fabrics did not receive a pass by the AATCC standard.

WATER REPELLENCY

"Our results show compelling evidence that wet abrasion compromises the water repellency of the fabric more greatly than dry abrasion, causing the surface to absorb more water when next exposed to rain."

The EN 29865 standard uses a Bundesmann instrument to conduct a rain shower test. This test was used to establish the effect of abrasion testing had on the water repellency of the fabrics.

For this test fabrics are mounted on cups and exposed to an artificial rain shower under defined conditions. The test consists of 4 parts:

- Visual comparison with reference photographs
- Observation of occurence of wetting to the underside
- The water absorbed by the specimen, weighed to an accuracy of 0.01g and expressed in a percentage
- Water penetrating the specimens, collected in cups and volume recorded

Fabric 1				
Specimen State	Visual Grade	Occurrence of Wetting to Underside	% Water Absorbtion	Water Penetration ml
Original	4	No	20.13	0
Dry	1	No	30.62	0
Wet	1	No	33.44	0

Fabric 2				
Specimen State	Visual Grade	Occurrence of Wetting to Underside	% Water Absorbtion	Water Penetration ml
Original	4	Yes	8.88	0
Dry	2	Yes	27.44	0
Wet	1	Yes	40.00	0

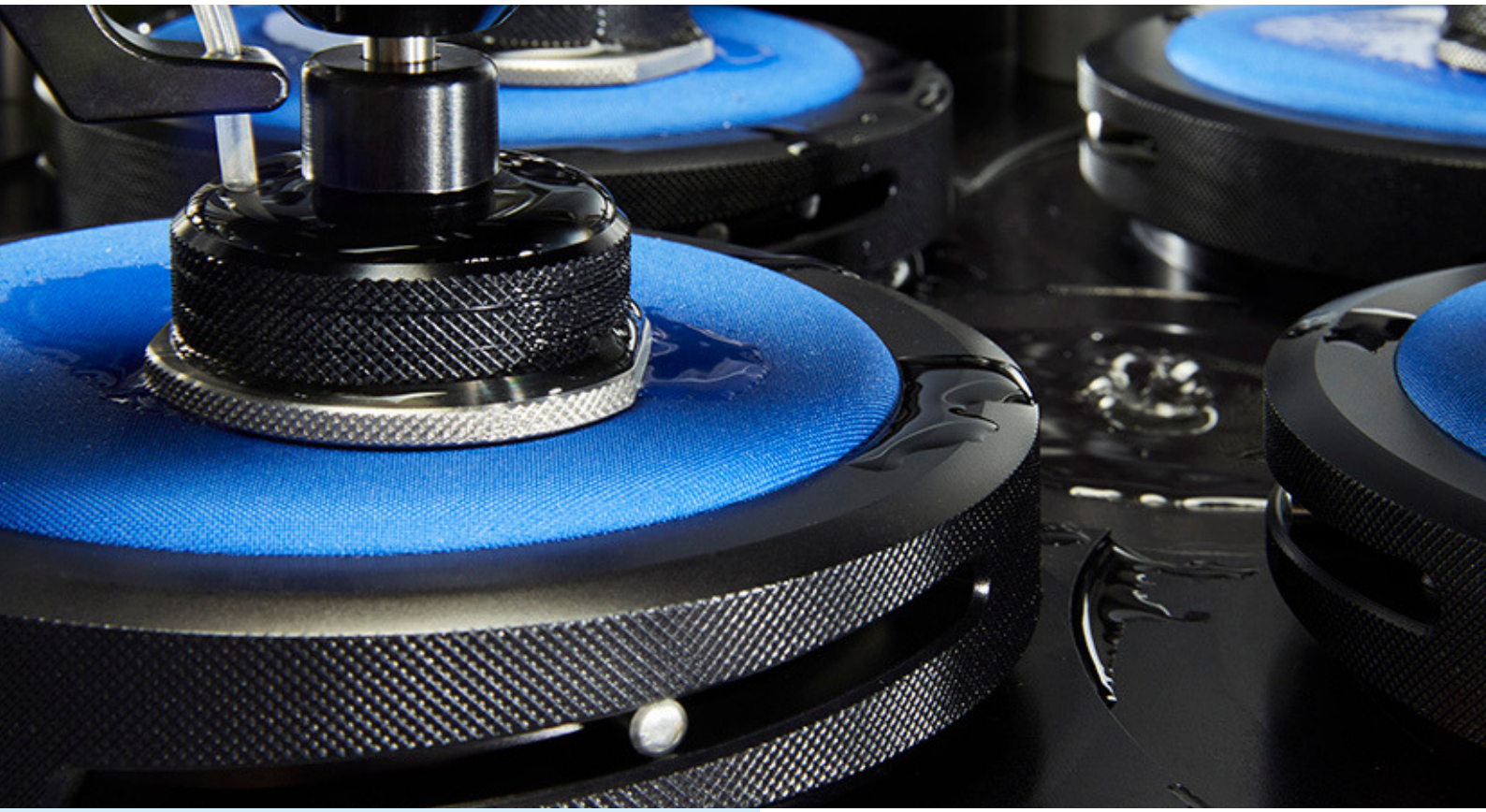
Fabric 3				
Specimen State	Visual Grade	Occurrence of Wetting to Underside	% Water Absorbtion	Water Penetration ml
Original	2	Yes	30.67	2
Dry	1	Yes	33.77	1
Wet	1	Yes	40.68	1

Fabric 4				
Specimen State	Visual Grade	Occurrence of Wetting to Underside	% Water Absorbtion	Water Penetration ml
Original	3	Yes	13.04	3
Dry	2	Yes	14.77	8
Wet	2	Yes	15.22	3

Fabric 5				
Specimen State	Visual Grade	Occurrence of Wetting to Underside	% Water Absorbtion	Water Penetration ml
Original	5	No	11.97	0
Dry	1	No	22.27	0
Wet	1	No	23.74	0

The results from this test show compelling evidence that wet abrasion compromises the water repellency of the fabric more greatly than dry abrasion, causing the surface to absorb more water when next exposed to rain. In many cases, the increase in absorption and degradation of the water repellency cannot be detected visually, proving that AquAbrasion determines how fabric performs after being subjected to true-life testing, revealing the damage that cannot be seen.

A note of Fabric 4 - the Water Absorption Percentage, like the other fabrics tested, was higher for wet abrasion than dry, however the Water Penetration volume was significantly lower. This is considered to be an outlier.



THE CONCLUSION

Fabrics subjected to wet abrasive stresses degenerate at a faster rate both aesthetically and physically, as proven by the range of testing we completed in this report.

These qualities are something manufacturers would want to consider when producing or purchasing a textile, particularly when making claims about performance in inclement weather conditions.

AquAbrasion is a controlled and accurate way of replicating real life conditions, and is proven to be a crucial first step to prove garment performance.

"The performance of a fabric is more greatly impaired when subjected to conditions for which it is intended, rather than generic dry test conditions."

GARMENTS THAT LAST

Consumers are placing more importance on garments that last, with a move away from fast fashion towards more sustainable options.

Quality is also of top importance with outdoor wear and athleisure, where the manufacturer is making a claim about the performance of a garment. The consumers expectations are raised - they expect the garment to perform and to last.

AquAbrasion can help with this - by ensuring the garment is tested in the conditions it will be used, the manufacturer can guarantee the improved lifespan of their product. This is great news for the environment, and for the brand's reputation as well.


Maxi-Martindale
Thu 17:00:08
James Heal