

Shield by Panaz®:

Antibacterial Efficacy Over Time.

Intro

To demonstrate the lasting nature of Shield Antimicrobial Technology, we utilized the "Soil Test" to replicate accelerated passage of time and highlight any diminution of the effectiveness of the fabric after extreme levels of exposure to microbes.

The Soil Test allowed us to create a scenario whereby the fabric was buried within an intense soup of microbes, far beyond anything likely to be encountered in normal hospital life, demonstrating the endurance of the antimicrobial properties even after such acute exposure.

The soil test procedure is generally recognized as the most severe biological exposure for textile products. The fabric samples are buried in warm, moist, live soil (compost/decayed organic matter) and the extent of rotting assessed against a control and by the measurement of residual tensile strength. Of course, tensile strength is not the issue for us here ... we are seeking to establish prolonged and enduring antimicrobial activity. Imagine the burial of an antimicrobial fabric in a 'live' compost for 28 days at 86° F. This is an extreme acceleration of activity representative of intensive use over an accelerated period of time.

The exposure to a 'live' compost replicates time and produces surface erosion of the fabric and, accordingly, highlights the potential for depletion and erosion of antimicrobial effectiveness. There are billions of micro-organisms typically found in a gram of compost so the fabric is under extreme duress.

The Soil Test

The untreated control sample had less than 20% strength retention after 7 days soil burial, demonstrating the viability of the test conditions. What was of interest was the fact that these fabric samples would be confined within the active soil for the prescribed amount of time and that the test conditions would expose the antimicrobial treatments to an exhaustive test of its enduring characteristics.

Following this confinement, samples of both the Shield and Silver Technology were sent to MSL Laboratories to perform antimicrobial testing.

Heat sterilization took place to cleanse the fabric of the compost remains then testing was performed to establish the antimicrobial activity. Testing for non-leaching antimicrobials performed under dynamic contact conditions: ASTM E2149-10 and testing for leaching antimicrobials AATCC147: 2004. The selected microbes were E Coli and MRSA.

Results

Shield 1 (54/57" goods)

The test material Shield 1 was determined to have antimicrobial activity against both MRSA and E.coli. The test material produced a 3.75 log reduction (99.98%) against E.coli and a 4.01 log reduction (99.99%) against MRSA.

Shield 2 (72" goods)

The test material Shield 2 was determined to have antimicrobial activity against both MRSA and E.coli. The test material produced a 1.21 log reduction (93.87%) against E.coli and a 2.5 log reduction (99.68%) against MRSA.

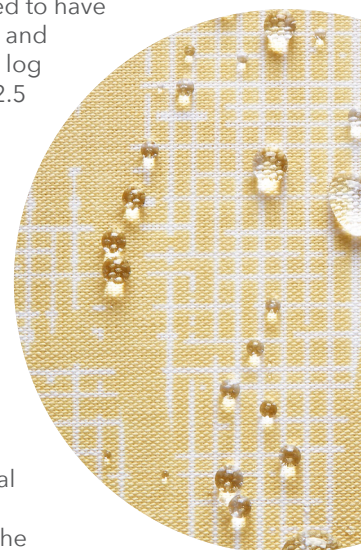
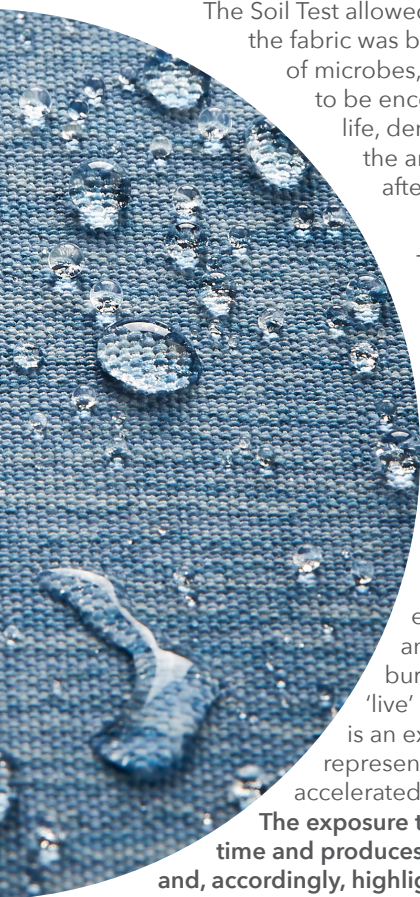
Silver Technology

The test material showed no zone of inhibition when placed in contact with MRSA. Limited growth was observed underneath the fabric, suggesting a low level of antimicrobial activity.

Conclusion

While Silver Technology showed no zone of inhibition, Shield has provided us with impressive antimicrobial efficacy after enduring an extremely intense environment as shown through the results of the soil test, making Shield the clear choice for enduring antimicrobial effectiveness.

*Note that 100% not a possibility due to the way the test is formulated.



LABORATORY TEST REPORT

SERIAL NO. 5398/B/C

**To: Panaz Ltd
Bentley Wood Way
Hapton
Burnley
BB11 5ST**

Purchase Order 125069
Lab ref: 5398/B/C
Report date: 02/10/18

FAO Kelly Briggs

1. Objective

To assess the resistance to rotting of four fabric samples

2. Test Samples

Five fabric samples were received as follows:

- Sample 1: Shield 1 Raw
- Sample 2: Shield 1 Treated and Printed
- Sample 3: Shield 2 Raw
- Sample 4: Shield 2 Treated and Printed
- Sample 5: X-Static

3. Test Method

Rot resistance Soil burial test BS 6085:1992

5. Test results

Test results are summarised as follows:

5.1 Soil burial test to British Standard 6085, Section 2

This procedure is generally recognised to be the most severe biological exposure for textile products.

In the test, samples of the fabric are buried in warm, moist soil and the extent of rotting is assessed by the measurement of residual tensile strength.

Fabric specimens were prepared from the samples supplied as described in the test method. A total of 10 specimens were prepared from each fabric sample. Five specimens from each sample were retained for the measurement of initial breaking strength.

The remaining five specimens from each sample were buried in a soil bed as described in the test method for a period of 28 days. During this time the soil bed was maintained at a temperature of $30^{\circ}\text{C} \pm 1^{\circ}\text{C}$.



Fabric strips in soil bed

Five specimens of an untreated control 100% cotton fabric (220 gm per sq. metre) were also buried in the soil bed for 7 days to act as viability controls.

After the burial period, the fabric specimens were removed from the soil bed, washed free of adhering soil particles using water and allowed to air dry at ambient temperature. The fabric specimens (both before and after the soil burial period) were then conditioned for 24 hours in a conditioning chamber held at a temperature of $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and a relative humidity of $65\% \pm 2\%$ prior to the measurement of breaking strength according to the test method described in BS EN ISO 13934. This utilizes a Hounsfield Tensometer H5KW-0053.



Tensometer



Tensometer detail



Tensometer with fabric strip loaded



Fabric strip showing break

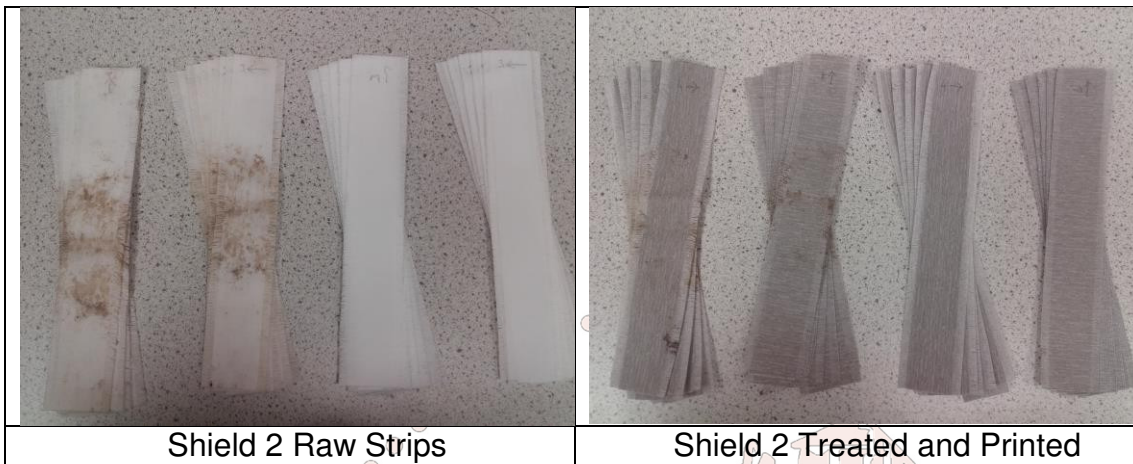
Images below show strips in original and post-burial condition before strength testing.



Shield 1 Raw Strips



Shield 1 Treated & Printed Strips



Shield 2 Raw Strips

Shield 2 Treated and Printed



X-Static Strips

The results obtained are shown in the following Tables.

Untreated control fabric buried for 7 days

Sample	Breaking Strength (Newtons)		Strength Retention	Strength Reduction
	Original	After Burial	After Burial	After Burial
Untreated				
1	626	93		
2	641	107		
3	633	62		
4	685	79		
5	654	68		
Mean	648	82	12.6%	87.4%

Fabric samples buried for 28 days

		Breaking Strength (Newtons)		Strength Retention	Strength Reduction
Sample		Original	After Burial	After Burial	After Burial
Shield 1 Raw	Warp				
1		1495	1457		
2		1527	1455		
3		1453	1461		
4		1571	1478		
5		1499	1499		
Mean		1509	1470	97.4%	2.6%
Shield 1 Raw	Weft				
1		727	715		
2		686	727		
3		682	688		
4		745	706		
5		737	662		
Mean		715	700	97.8%	2.2%
Shield 1 Treated & Printed	Warp				
1		1576	1526		
2		1518	1423		
3		1520	1472		
4		1544	1477		
5		1486	1457		
Mean		1529	1471	96.2%	3.8%
Shield 1 Treated & Printed	Weft				
1		764	859		
2		834	831		
3		783	854		
4		812	793		
5		783	895		
Mean		795	846	106%	0

Sample		Breaking Strength (Newtons)		Strength Retention	Strength Reduction
		Original	After Burial	After Burial	After Burial
Shield 2 Raw	Warp				
1		897	900		
2		901	908		
3		808	862		
4		858	867		
5		873	892		
Mean		867	892	102.8%	0
Shield 2 Raw	Weft				
1		938	890		
2		846	937		
3		913	954		
4		877	890		
5		916	871		
Mean		898	908	101.1%	0
Shield 2 Treated and Printed	Warp				
1		790	805		
2		820	781		
3		774	748		
4		766	847		
5		794	816		
Mean		790	799	101.2%	0
Shield 2 Treated and Printed	Weft				
1		928	941		
2		951	969		
3		990	964		
4		936	952		
5		940	879		
Mean		949	941	99.2%	0.8%

Sample		Breaking Strength (Newtons)		Strength Retention	Strength Reduction
		Original	After Burial	After Burial	After Burial
X-Static	Warp				
1		1066	1044		
2		1073	1060		
3		1032	1008		
4		1110	1012		
5		1054	1032		
Mean		1067	1031	96.7%	3.3%
X-Static	Weft				
1		545	574		
2		542	530		
3		580	551		
4		516	544		
5		502	567		
Mean		537	553	103.0%	0

6. Conclusions

- The untreated control sample had less than 20% strength retention after 7 days soil burial, demonstrating the viability of the test conditions.
- All fabrics show virtually no loss of strength post burial. For reference, an 80% or above strength retention would be noted as a good result.



Ian Johnston
Quality Technician

STUDY REPORT

Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents Under Dynamic Contact Conditions

ASTM E2149-10

Page 1 of 4

Job reference — **J000953**

Lab Ref/Report No.	J000953
Testing Laboratory Site Company owner	Microbiological Solutions Limited Gollinrod, Bury , BL9 5NB Angela Davies, Managing director
Report Date	23/11/2018
Period of Analysis	21/11/2018/22/11/2018

Customer	Panaz Ltd
Contact Name	Kelly Briggs
Address	Bentley Wood Way, Network 65 Business Park, Hapton, Burnley, Lancashire. BB1 9ST
Email	kelly.briggs@panaz.co.uk
PO Number	Q001436

Name of product	Shield 1 After Burial
Batch number	N/S
Manufacturer / Supplier	Panaz Ltd
Storage Conditions	Ambient
Appearance of the Product	Multi-coloured Striped Fabric
Method	E2149-10
Mass of test specimens	1g
Test Temperature	Ambient (20°C ± 1°C)
Identification of the reference strains	<i>Escherichia coli</i> NCTC 12241 (ATCC 25922) MRSA

STUDY REPORT

Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents Under Dynamic Contact Conditions

ASTM E2149-10

Page 2 of 4

Job reference — **J000953**

Overview

The client requested testing of antimicrobial properties of a treated fabric sample. As such ASTM E2149-10 has been applied.

Introduction

This test method is designed to evaluate the antimicrobial activity of non-leaching, antimicrobial specimens under dynamic contact conditions. Surface antimicrobial activity is determined by comparing results from the test sample to controls run simultaneously.

Test Method

In brief the method comprises three separate assessments. The first two assessments determine the presence of leaching antimicrobials, the final assessments determines the microbial activity of the product.

To assess if any leaching antimicrobials are present the sample is prepared in buffer solution without alcohol and placed under standard shaking conditions for 1 hour. An untreated control is prepared in parallel. At the end of the hour the fabric is removed from the sample. This liquid is the used to set up two tests, for one 100µl is added to a hole in an agar plate seeded with the test organism. The sample is then incubated and assessed for zones of clearing. The remaining liquid then has the test organism added at standard test concentrations and is shaken for 1 hour before recovering and enumerating the liquid. If these tests show no zone of clearing and no significant difference between the test and control material then the product is determined to not contain leachable antimicrobial agents.

Assessment antimicrobial activity of the fabrics is carried out by preparing a suspension of $1.5-3.0 \times 10^5$ cfu/ml of the test organism in the buffer solution. A 50ml portion of the inoculated buffer is placed in a sterile container and the test specimen added. The specimen is the shaken for 1 hour, after which an aliquot of the liquid is removed and enumerated. In parallel a control specimen and no specimen sample are tested.

The standard organism for this test is *Escherichia coli*.

Deviations from the standard method

The test material has previously been buried in soil, therefore to prevent contamination they were heat treated prior to testing. The fabric was tested against MRSA and E.coli.

STUDY REPORT**Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents
Under Dynamic Contact Conditions**

ASTM E2149-10

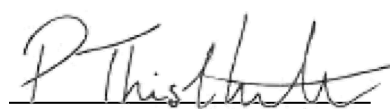
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Job reference — **J000953****Conclusion**

The product Shield 1 was determined to have antimicrobial activity against both MRSA and E.coli. The test material produced a 4.01 log reduction (99.99%) against MRSA and a 99.98% (3.75 log) reduction against E.coli.

See raw data tables below for test results.

The sample will be retained for 1 month unless otherwise requested.


Deputy Laboratory Manager
Megan Barrett
Technical Project Manager
Peter Thistlethwaite

The test results on this report refer only to the items tested. This report shall not be reproduced except in full and with written approval of Microbiological Solutions Ltd

STUDY REPORT

Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents Under Dynamic Contact Conditions

ASTM E2149-10

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Job reference — **J000953**

Test results

MRSA

MRSA	Replicate 1		Replicate 2		Replicate 3				Reduction	Reduction
Conditions	Dilution	Count	Dilution	Count	Dilution	Count	Average cfu/ml	log10 cfu/ml	log10	%
Control 1 hour	2	62	2	89	2	95	8200	3.91	N/A	N/A
Inoculum only 1 hour	3	51	3	63	3	71	61667	4.79	N/A	N/A
Test material	0	0	0	10	0	8	6	0.78	4.01	99.99%
Test Leaching assessment	1	61	1	70	1	70	670	2.83	1.96	98.91%

E.coli

E.coli	Replicate 1		Replicate 2		Replicate 3				Reduction	Reduction
Conditions	Dilution	Count	Dilution	Count	Dilution	Count	Average cfu/ml	log10 cfu/ml	log10	%
Control 1 hour	2	91	2	119	2	135	11500	4.06	N/A	N/A
Inoculum only 1 hour	3	39	3	39	3	41	39667	4.6	N/A	N/A
Test material	0	6	0	8	0	8	7	0.85	3.75	99.98%
Test Leaching assessment	1	46	1	46	1	66	527	2.72	1.88	98.67%

STUDY REPORT

Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents Under Dynamic Contact Conditions

ASTM E2149-10

Page 1 of 4

Job reference – J000936

Lab Ref/Report No.	J000936
Testing Laboratory Site Company owner	Microbiological Solutions Limited Gollinrod, Bury , BL9 5NB Angela Davies, Managing director
Report Date	01/11/2018
Period of Analysis	26/10/2018-29/10/2018

Customer	Panaz Ltd
Contact Name	Kelly Briggs
Address	Bentley Wood Way, Network 65 Business Park, Hapton, Burnley, Lancashire. BB1 9ST
Email	kelly.briggs@panaz.co.uk
PO Number	Q001400

Name of product	Shield 2 (after burial)
Batch number	N/S
Manufacturer / Supplier	Panaz Ltd
Storage Conditions	Ambient
Appearance of the Product	Brown/Grey fabric
Method	E2149-10
Mass of test specimens	1g
Test Temperature	Ambient (20°C $\pm$ 1°C)
Identification of the reference strains	<i>Escherichia coli</i> NCTC 12241 (ATCC 25922) <i>MRSA</i> NCTC 12493

STUDY REPORT

Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents Under Dynamic Contact Conditions

ASTM E2149-10

Page 2 of 4

Job reference – J000936

Overview

The client requested testing of antimicrobial properties of a treated fabric sample. As such ASTM E2149-10 has been applied.

Introduction

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Test Method

In brief the method comprises three separate assessments. The first two assessments determine the presence of leaching antimicrobials, the final assessments determines the microbial activity of the product.

To assess if any leaching antimicrobials are present the sample is prepared in buffer solution without alcohol and placed under standard shaking conditions for 1 hour. An untreated control is prepared in parallel. At the end of the hour the fabric is removed from the sample. This liquid is the used to set up two tests, for one 100µl is added to a hole in an agar plate seeded with the test organism. The sample is then incubated and assessed for zones of clearing. The remaining liquid then has the test organism added at standard test concentrations and is shaken for 1 hour before recovering and enumerating the liquid. If these tests show no zone of clearing and no significant difference between the test and control material then the product is determined to not contain leachable antimicrobial agents.

Assessment antimicrobial activity of the fabrics is carried out by preparing a suspension of $1.5-3.0 \times 10^5$ cfu/ml of the test organism in the buffer solution. A 50ml portion of the inoculated buffer is placed in a sterile container and the test specimen added. The specimen is the shaken for 1 hour, after which an aliquot of the liquid is removed and enumerated. In parallel a control specimen and no specimen sample are tested.

The standard organism for this test is *Escherichia coli*.

Deviations from the standard method

The sample had been previously buried in a soiled condition, therefore to prevent contamination in the test the fabric was heat treated before testing took place. The test was performed against E.coli and MRSA.

STUDY REPORT**Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents
Under Dynamic Contact Conditions**

ASTM E2149-10

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Job reference – J000936

Conclusion

The test material **Shield 2 (After burial)** showed some level of antimicrobial activity against E.coli with a 1.21 log reduction (93.87%).

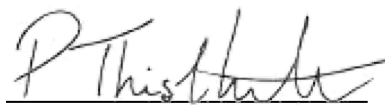
A higher level of antimicrobial activity was seen against MRSA, where a 2.5 log reduction (99.68%) was achieved.

See raw data tables below for test results.

The sample will be retained for 1 month unless otherwise requested.



Deputy Laboratory Manager
Megan Barrett



Technical Project Manager
Peter Thistlethwaite

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STUDY REPORT

Determining the Antimicrobial Activity of Immobilized Antimicrobial Agents Under Dynamic Contact Conditions

ASTM E2149-10

Page 4 of 4

Job reference – J000936

Test results

E.coli	Replicate 1		Replicate 2		Replicate 3		Average cfu/ml	log10 cfu/ml	Reduction	Reduction
Conditions	Dilution	Count	Dilution	Count	Dilution	Count			log10	%
Control 1 hour	1	84	1	83	1	70	790	2.9	N/A	N/A
Inoculum only 1 hour	2	26	2	24	2	20	2333	3.37	N/A	N/A
Test material	0	160	0	151	0	119	143	2.16	1.21	93.87%
Test Leaching assessment	0	189	0	161	0	159	170	2.23	1.14	92.71%

MRSA	Replicate 1		Replicate 2		Replicate 3		Average cfu/ml	log10 cfu/ml	Reduction	Reduction
Conditions	Dilution	Count	Dilution	Count	Dilution	Count			log10	%
Control 1 hour	1	55	1	50	1	56	537	2.73	N/A	N/A
Inoculum only 1 hour	2	36	2	37	2	30	3433	3.54	N/A	N/A
Test material	0	0	0	19	0	15	11	1.04	2.5	99.68%
Test Leaching assessment	1	56	0	53	0	51	221	2.34	1.2	93.56%

XSTATIC ANTIMICROBIAL TESTING

Parallel Steak Method AATCC 147:2004 for Leaching Antimicrobials

Study Title:

Antibacterial Activity Assessment to Textile Materials: Parallel Steak Method AATCC 147:2004

Page 1 of 5

Job reference – J000936

Customer	Panaz Ltd
Contact Name	Kelly Briggs
Address	Bentley Wood Way, Network 65 Buisness Park, Hapton, Burnley, Lancashire, BB1 9ST
Email	kelly.briggs@panaz.co.uk
PO Number	Q001400

Lab Ref	J000936
Report Date	01/11/2018
Period of Analysis	30/10/2018-01/11/2018

Name of product	X-Static after burial
Batch number	N/S
Manufacturer / Supplier	Panaz Ltd
Storage Conditions	Ambient
Appearance of the Product	Green fabric – X-Static
Method	AATCC 147-2004
Temperature of Incubation	Bacteria - 37°C ±1°C
Identification of the Bacterial strains:	MRSA NCTC 12493
Incubation Time	24hr + 1hr

Study Title:

Antibacterial Activity Assessment to Textile Materials: Parallel Steak Method AATCC 147:2004

Page 2 of 5

Job reference – J000936

Introduction

This method has been designed to detect bacteriostatic activity in textile materials.

Outline of Test Method

Specimens of the test material, including corresponding untreated controls of the same material, are placed in intimate contact with the agar which has been previously streaked with an inoculum of test bacterium. After incubation, a clear area of interrupted growth underneath and along the sides of the test material indicates antibacterial activity of the specimen. Testing is performed in duplicate.

Deviations from Standard Method

The product was tested using the parallel streak method, alongside a bacterial lawn plate for comparison. The samples had been buried in soil prior to testing and were heat treated to prevent contamination.

Study Title:

Antibacterial Activity Assessment to Textile Materials: Parallel Steak Method AATCC 147:2004

Page 3 of 5

Job reference – J000936

Acceptance Criteria

The product when tested as above shall demonstrate a clear area of interrupted growth underneath and along the sides of the test material indicating antibacterial activity of the specimen.

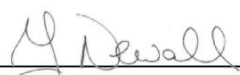
Conclusion

The test product **X-static** showed no zone of inhibition when placed in contact with MRSA. Limited growth was observed underneath the fabric, suggesting a low level of antimicrobial activity.

See raw data tables below for test results.

The sample will be retained for 1 month unless otherwise requested.



Deputy Laboratory Manager
Megan Barrett

Senior Microbiologist
Yvie Newall

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Study Title:
Antibacterial Activity Assessment to Textile Materials: Parallel Steak Method
AATCC 147:2004

Job reference – J000936

Test Results:

X-Static

Organism	Treated Fabric Zone of Inhibition Under Fabric	Untreated Control Fabric Zone of Inhibition under fabric
<i>MRSA</i>	Some growth Observed	No Zone of Inhibition - Growth Observed

Study Title:

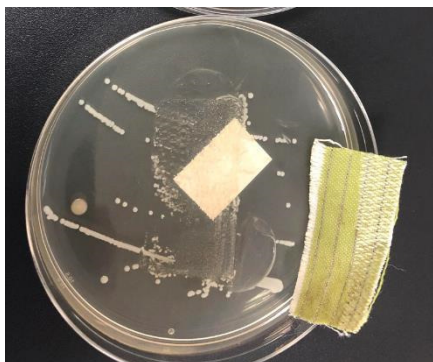
Antibacterial Activity Assessment to Textile Materials: Parallel Steak Method

AATCC 147:2004 Page 5 of 5

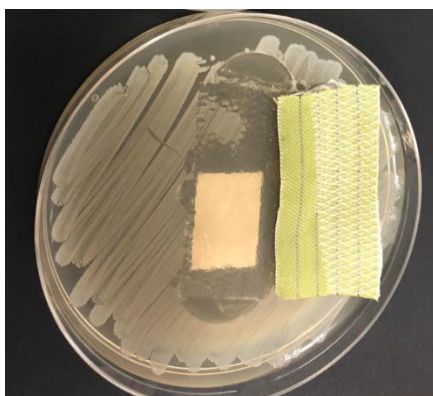
Job reference – J000936

Reference Images

X-static



Streak plate, growth observed under fabric placement.



Lawn plate, growth observed under fabric placement.

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Company Number: 4218514