“Comparative Study on Different Test Requirements of All Over Printing-AOP.”

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Daffodil International University

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Letter of Approval

June 01, 2024

To

The Head

Department of Textile Engineering

Subject: Approval of Project Report of M.Sc. in TE Program.

Dear Sir,

I am writing to let you know that this project report titled "Comparative Study on Different Test Requirements of All Over Printing-AOP" has been prepared by the student bearing ID: 0242220014123003and is completed for final evaluation. The whole report is designed based on the proper investigation and interruption through critical analysis of empirical data with required belongings. The student was directly involved in their project activities, and the report became vital to spark valuable information for the readers.

Therefore, please accept this project report and consider it for final evaluation.

Yours Sincerely

.....

Mr. Tanvir Ahmed Chowdhury

Assistant Professor & Head (In-Charge)

Department of Textile Engineering

Faculty of Engineeriing

DECLARATION

I, at this moment, declare that we have done this project under the super vision of **Mr. Tanvir Ahmed Chowdhury** Assistant Professor & Head (In-Charge), Department of Textile Engineering, Faculty of Engineering, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted for award of any degree or diploma.

.....

Md. Taufiqul Islam
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This is to authorize that the above declaration by the applicant is correct to the best of my knowledge.

Supervisor:

.....

Mr. Tanvir Ahmed Chowdhury
Assistant Professor & Head (In-Charge)
Department of Textile Engineering
Faculty of Engineering

ACKNOWLEDGEMENT

I humbly thank Allah, the Almighty, for giving us the capacity and freedom to complete this thesis. My respected and knowledgeable teacher and guide **Mr. Tanvir Ahmed Chowdhury Assistant Professor & Head (In-Charge), Department of Textile Engineering, Faculty of Engineeriing, Daffodil International University,DIU Smart City, Ashulia, Savar, Dhaka** deserves my sincere gratitude and deep sense of indebtedness, which I have the pleasure of expressing.

In order to complete the task effectively, I would want to express my sincere gratitude to esteemed instructor and mentor assistant professor **Mr. Tanvir Ahmed Chowdhury** for his steady and unwavering supervision, helpful suggestions, and constructive criticism. Without his adequate leadership, monitoring, helpful suggestions it would not have been possible to me to take even a single step forward to attain our intended goal in time. I shall always be grateful to him.

I'm also grateful to our esteemed teachers for their unwavering encouragement and practical assistance throughout the project. I'm also grateful to the entire staff of the textile engineering department for their insightful counsel throughout the writing of my thesis. I would like to thanks our entire course mate in daffodil International University, who took part in this discuss while completing the course work.

I also want to express my gratitude to the autoclave operators, who were in charge, for their ongoing support and technical assistance. I also gather a lot of data before visiting the labs at the university and in the company.

Last but not least, I must respectably appreciate my mother's unwavering assistance and patience.

Dedication to us Respected Parents & Beloved Teacher.

ABSTRACT

All Over Printing (AOP) has emerged as a prominent technique in the realm of textile and graphic printing, offering expansive design possibilities across various industries. However, ensuring quality and durability in AOP necessitates a comprehensive understanding of its test requirements. This comparative study aims to explore and analyze the diverse test requirements associated with AOP processes, highlighting variations in approaches across different industries and applications.

The study begins by outlining the fundamental principles of AOP and its significance in contemporary printing practices. It then delves into an examination of test requirements, encompassing parameters such as colorfastness, durability, washability, and environmental sustainability. By scrutinizing standards and guidelines set forth by regulatory bodies, industry associations, and individual companies, this study provides a comprehensive overview of the testing landscape for AOP.

Furthermore, the comparative analysis elucidates discrepancies and commonalities among test requirements across various sectors utilizing AOP, including fashion, home décor, promotional products, and digital printing. Through the juxtaposition of different approaches, this study offers insights into the factors influencing test requirements, such as material type, printing method, intended application, and end-user expectations.

Moreover, the study investigates the role of technological advancements, such as digital printing innovations and eco-friendly ink formulations, in shaping test requirements and compliance standards for AOP. It also considers the impact of global supply chain dynamics and evolving consumer preferences on the testing landscape.

By synthesizing empirical data, industry reports, and scholarly literature, this comparative study contributes to a nuanced understanding of the multifaceted test requirements associated with AOP. It sheds light on the complexities inherent in ensuring quality and performance in AOP processes while navigating diverse regulatory frameworks and market demands. In conclusion, the findings underscore the importance of harmonizing test requirements across industries, fostering collaboration among stakeholders, and leveraging emerging technologies to enhance the reliability and sustainability of AOP applications. This study lays the

groundwork for future research endeavors aimed at refining testing protocols, advancing quality assurance practices, and promoting innovation in the field of All Over Printing.

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CHAPTER-1

INTRODUCTION

1.1 Background of the Study:

All Over Printing (AOP) is a technique used in the textile industry to apply designs over the entire surface of a fabric. This method allows for continuous and seamless patterns, making it popular in fashion, home textiles, and various other applications. The process involves various printing techniques such as screen printing, digital printing, and rotary printing, each with its specific requirements and challenges.

Testing the quality and durability of AOP fabrics is crucial to ensure they meet industry standards and consumer expectations. Different tests are conducted to assess various aspects such as color fastness, fabric strength, print durability, and environmental impact. These tests vary depending on the printing technique used, the type of fabric, and the intended use of the final product. Understanding these test requirements and their implications is vital for manufacturers to maintain quality and compliance with international standards.

1.2 Objective of the Study:

- **Broad Objective: To evaluate and compare the test of pigment, reactive, and discharge printed fabrics**

✓ To attain the main objectives the following specific objectives will be achieved:

✓ To test the colorfastness of pigment, reactive, and discharge printed fabrics with respect to various destructive factors such as washing, exposure to light and rubbing.

✓ To evaluate the durability of pigment, reactive, and discharge printed fabrics with respect to wear and tear and resistance to pilling and abrasion.

1.3 Significance of the Study:

- **Quality Assurance:** By comparing different test requirements, manufacturers can better understand how to ensure high-quality AOP products that meet consumer expectations and industry standards.
- **Process Optimization:** Insights from the study can help in optimizing printing processes, leading to more efficient production and cost savings. Identifying the best practices for different printing techniques can enhance the overall quality of the products.

- **Standardization:** The study can contribute to the development of standardized testing protocols for AOP fabrics, facilitating consistency and reliability across the industry. Standardized tests ensure that products from different manufacturers meet the same quality benchmarks.
- **Innovation and Development:** Understanding the strengths and limitations of various testing methods can drive innovation in testing technologies and methodologies. This can lead to the development of new, more effective testing procedures and the improvement of existing ones.
- **Consumer Satisfaction:** Ensuring that AOP products undergo rigorous testing and meet high standards can enhance consumer trust and satisfaction. High-quality products that withstand wear and tear, washing, and environmental exposure will likely lead to increased customer loyalty.
- **Environmental and Regulatory Compliance:** The study can provide insights into the environmental impact of different printing techniques and the necessary tests to ensure compliance with environmental regulations. This is increasingly important in a market that is becoming more environmentally conscious.

1.4 Limitations of the Study:

- **Scope of Testing Techniques:** The study might be limited by the range of testing techniques and standards covered. Given the diversity in printing methods and fabric types, it may not be feasible to cover every possible combination comprehensively.
- **Resource Constraints:** Conducting a comprehensive comparative study requires significant resources, including access to various testing equipment, materials, and expertise. Limited resources may restrict the depth and breadth of the study.
- **Variability in Fabric and Print Quality:** Inherent variability in the quality of fabrics and printing processes can affect the results of the tests. This variability makes it challenging to draw definitive conclusions that are universally applicable.
- **Rapid Technological Advancements:** The textile printing industry is continuously evolving, with new technologies and methods emerging regularly. The study may become outdated quickly if it does not account for the latest advancements.

- **Regional Differences in Standards:** Different regions may have varying standards and regulations for textile printing and testing. The study may not be able to account for all these differences, potentially limiting its global applicability.
- **Human and Subjective Factors:** Some aspects of testing, such as visual assessments of print quality, can be subjective and prone to human error. This subjectivity can introduce biases into the study's findings.

1.5 Defination of Quality:

American Society for Quality Control (ASQC) defines quality as "A systematic approach to the search for excellence. According to International Standard Organization (ISO), "Quality is the fulfillment of the specified requirements for a product or service".

1.6 4 Point System: The four-point assessment method is a commonly established method of fabric inspection globally. Fabric inspection is done as per ASTM D 5430–04 standard and this system is agreed by The American Society for Quality Control, Textile and Needle Trades Division, The American Apparel Manufacturers Association and is used by the United States Government for all of their piece goods purchased.

1.7 Advantage of 4 Point System:

- ✓ 4 point system has no width limitation.
- ✓ Worker can easily understand it.

1.8 Testing:

Textile testing is the process of determining the physical and chemical properties of textiles to ensure they meet quality standards and regulatory requirements. Testing is a critical step in the manufacturing process as it helps to identify any defects or issues before the product is released into the market. In this response, I will discuss the importance of textile testing, as well as some common methods and techniques used in the industry.

1.9 Benefits of Testing:

a) Quality Control;
b) Compliance with regulations;
c) Product development;
d) Marketing;

1.10 Buyer's / Customer Aspects of AOP:

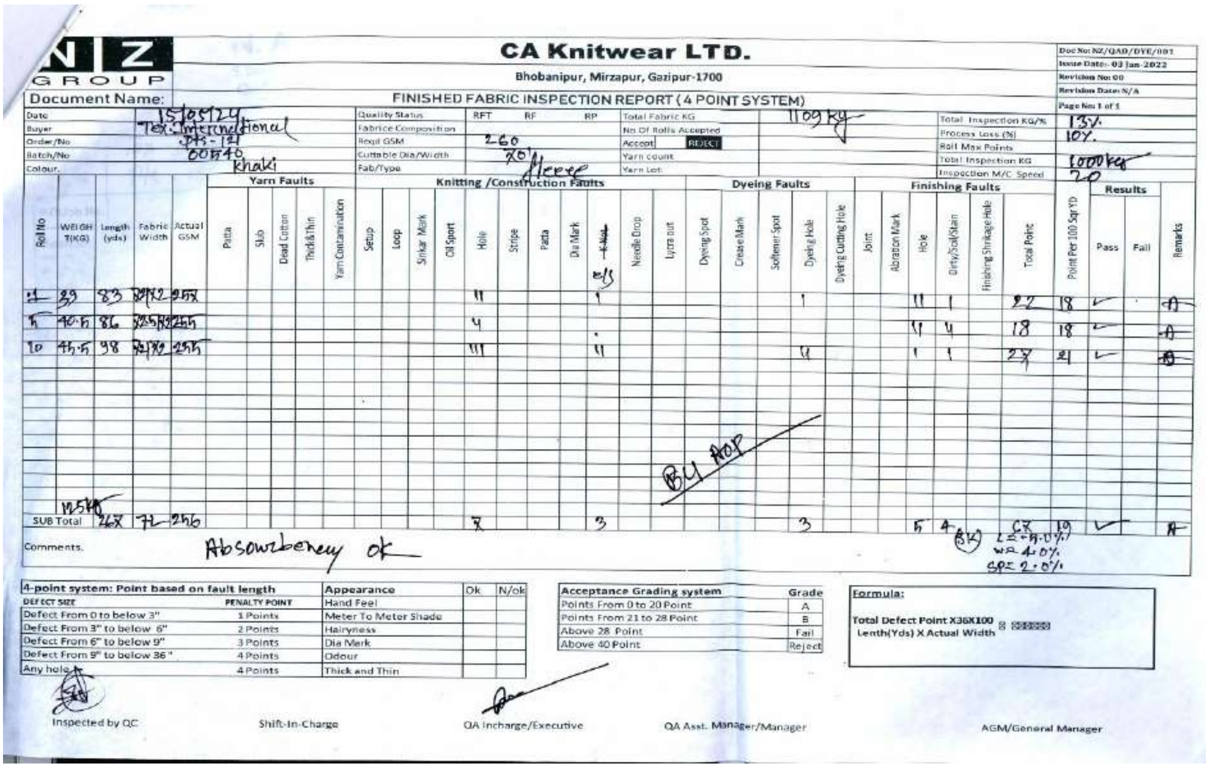
a. Design Asthetics Looks,
b. Design Aperance,

c. Design Sharpness and Clarity of AOP.
d. Color Accuracy,
e. Required Fabric Composition,
f. Approprite Repeat Measurment,
g. Hand Feel,
h. Approprite GSM,
i. Required GSM,
j. Cutable Dia,
k. Smoth Surface,
l. Actual AOP Route.

1.11 Quality Control: QC is **reactive**, involving inspection, testing, and defect correction post-production.

1.12 Quality Assurance: QA is a proactive process that prevents defects and ensures quality standards throughout production or service delivery.

1.13 Before AOP Inspection:



NZ GROUP

CA Knitwear LTD.

Bhobanipur, Mirzapur, Gazipur-1700

Document Name: FINISHED FABRIC INSPECTION REPORT (4 POINT SYSTEM)

Doc No: NZ/QAD/DYE/001
Issue Date:- 03 Jan-2022
Revision No: 00
Revision Date: N/A
Page No: 1 of 1

Date	15/05/24	Quality Status	RFT RF RP	Total Fabric KG	1109 kg
Buyer	Tex: International	Fabrice Composition		No Of Rolls Accepted	
Order/No	PTS-121	Reqd GSM	260	Accept REJECT	
Batch/No	00540	Cuttable Dia/Width	70"	Yarn count	
Colour	Khaki	Fab/Type	fleece	Yarn Lot	

Total Inspection KG/%	13%
Process Loss (%)	10%
Roll Max Points	
Total Inspection KG	1000 kg
Inspection M/C Speed	20

Roll No	WEIGHT (KG)	Length (yds)	Fabric Width	Actual GSM	Yarn Faults: Patta	Slub	Dead Cotton	Thick&Thin	Yarn Contamination	Knitting /Construction Faults: Setup	Loop	Sinkar Mark	Oil Sport	Hole	Stripe	Patta	Dia Mark	K-Mat e/s	Needle Drop	Lycra out	Dyeing Faults: Dyeing Spot	Crease Mark	Softener Spot	Dyeing Hole	Dyeing Cutting Hole	Joint	Abration Mark	Finishing Faults: Hole	Dirty/Soil/Stain	Finishing Shrikage Hole	Total Point	Point Per 100 Sqr YD	Results: Pass	Fail	Remarks
1	39	83	[illegible]	257										11				1						1				11	1		22	18	✓		A
5	40.5	86	[illegible]	255										4														11	4		18	18	✓		A
10	45.5	98	[illegible]	255										111				11						11				1	1		27	21	✓		A
SUB Total 125 kg	267	72-256												7				3						3				5	4		67	19	✓		A

By AOP

Comments. Absowrbency ok
(SK) L= -5.0% W= 4.0% SP= 2.0%

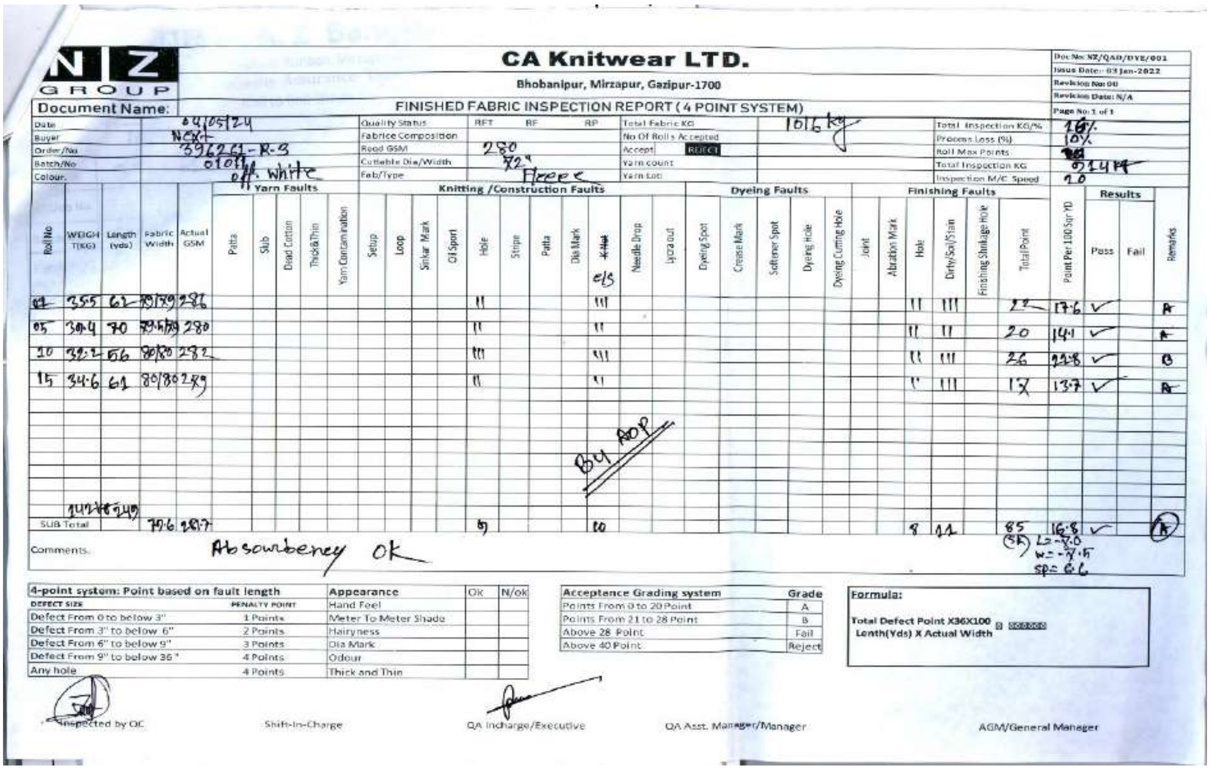
4-point system: Point based on fault length		Appearance	Ok	N/ok
DEFECT SIZE	PENALTY POINT	Hand Feel		
Defect From 0 to below 3"	1 Points	Meter To Meter Shade		
Defect From 3" to below 6"	2 Points	Hairyness		
Defect From 6" to below 9"	3 Points	Dia Mark		
Defect From 9" to below 36"	4 Points	Odour		
Any hole	4 Points	Thick and Thin		

Acceptance Grading system	Grade
Points From 0 to 20 Point	A
Points From 21 to 28 Point	B
Above 28 Point	Fail
Above 40 Point	Reject

Formula:
Total Defect Point X36X100 / Lenth(Yds) X Actual Width

Inspected by QC | Shift-In-Charge | QA Incharge/Executive | QA Asst. Manager/Manager | AGM/General Manager

Picture-01 before AOP Inspection Report Prepared by Offline QI.



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Bhobanipur, Mirzapur, Gazipur-1700

Doc No: NZ/QAD/DYE/001, Issue Date: 03 Jan-2022, Revision No: 00, Revision Date: N/A, Page No: 1 of 1

Document Name: FINISHED FABRIC INSPECTION REPORT (4 POINT SYSTEM)

Date: 04/05/24; Buyer: NEXT; Order/No: 596261-R-3; Batch/No: 01011; Colour: off. white; Total Fabric KG: 1016 kg; Total Inspection KG/%: 16%; Process Loss: 10%; Total Inspection KG: 214 kg; Inspection M/C Speed: 20; Fab/Type: Fleece

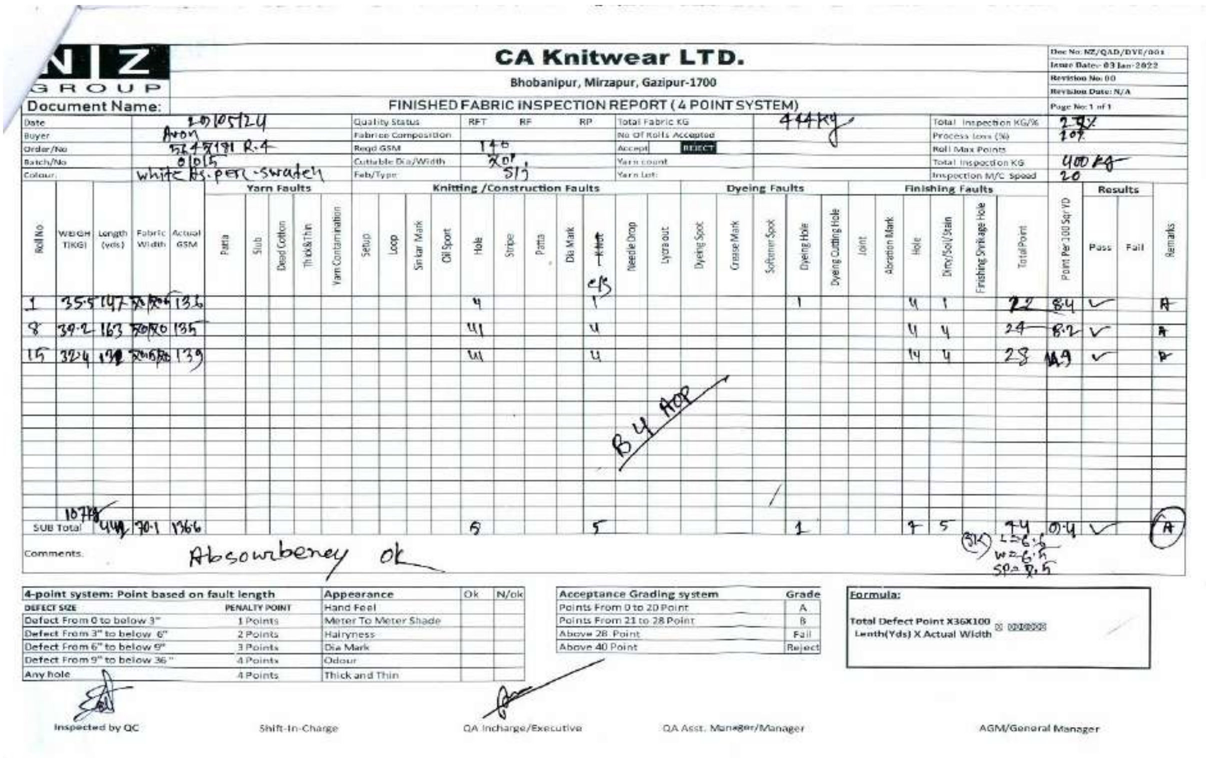
Roll No	Weight (KG)	Length (yds)	Fabric Width	Actual GSM	Hole	e/s	Hole	Dirty/Soil/Stain	Total Point	Point Per 100 Sq YD	Pass	Remarks
01	35.5	62	80/79	281	II	III	II	III	22	17.6	✓	A
05	30.4	70	80/79	280	II	II	II	II	20	14.1	✓	A
10	32.2	56	80/80	282	III	III	II	III	26	22.8	✓	B
15	34.6	61	80/80	279	II	II	II	III	17	13.7	✓	A
SUB Total					9	10	8	11	85	16.8	✓	A

By AOP

Comments: Absorbency ok

L=-8.0, W=-7.5, SP=6.6

Picture-02 before AOP Inspection Report Prepared by Offline QI.



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CA Knitwear LTD.

Bhobanipur, Mirzapur, Gazipur-1700

Document Name: FINISHED FABRIC INSPECTION REPORT (4 POINT SYSTEM)

Date: 20/05/24; Buyer: Avon; Order/No: 5247191 R.4; Batch/No: 0105; Colour: white HS-peri-swatch; Total Fabric KG: 414 kg; Total Inspection KG/%: 29%; Process Loss: 10%; Total Inspection KG: 400 kg; Inspection M/C Speed: 20

Roll No	Weight (KG)	Length (yds)	Fabric Width	Actual GSM	Hole	e/s	Dyeing Hole	Hole	Dirty/Soil/Stain	Total Point	Point Per 100 Sq YD	Pass	Remarks
1	35.5	147	70/70	136	4	1	1	4	1	22	8.4	✓	A
8	39.2	163	70/70	135	41	4		4	4	24	8.2	✓	A
15	39.4	140	70/70	139	41	4		14	4	28	11.9	✓	A
SUB Total	114	401	70.1	136.6	6	5	1	9	5	74	9.4	✓	A

By AOP

Comments: Absorbency ok

L=-6.5, W=-6.5, SP=8.5

Picture-03 before AOP Inspection Report Prepared by Offline QI.

1.14 After AOP Inspection:

N. A. Z Bangladesh Ltd.

5, bishuya Kuribari, Mirzapur, Gazipur-1700
Quality Assurance- Textile Division
Roll to Roll Shade Continuity Card

Doc No.:	NZ/QAD/DYE/007
Issue Date:	03 Jan 2022
Rivision No.	00
Rivision Date:	N/A

Buyer Name:	Next			Date:	10/05/24
Order No.	401849			Batch Qty:	345 kg
P.O/Job No.				Color:	off white (AOP)
Batch No.	1566	Batch SL No.		Req. GSM:	180 OK
Fabric Type:	SJ			Act. GSM:	

Prepared By

Checked By

Picture-01 after print, finished shade card.

N. A. Z Bangladesh Ltd.

5, bishuya Kuribari, Mirzapur, Gazipur-1700
Quality Assurance- Textile Division
Roll to Roll Shade Continuity Card

Doc No.:	NZ/QAD/DYE/007
Issue Date:	03 Jan 2022
Rivision No.	00
Rivision Date:	N/A

Buyer Name:	Matalan	Date:	07/06/24
Order No.	JCW24NW167	Batch Qty:	350Kg
P.O/Job No.		Color:	L. white (AOP)
Batch No.	2681 (Batch SL No.)	Req. GSM:	140
Fabric Type:	SJ	Act. GSM:	OK 07/06/24

Act. GSM

Prepared By

Checked By

Picture-02 after print, finished shade card.

N.A.Z Bangladesh Ltd.

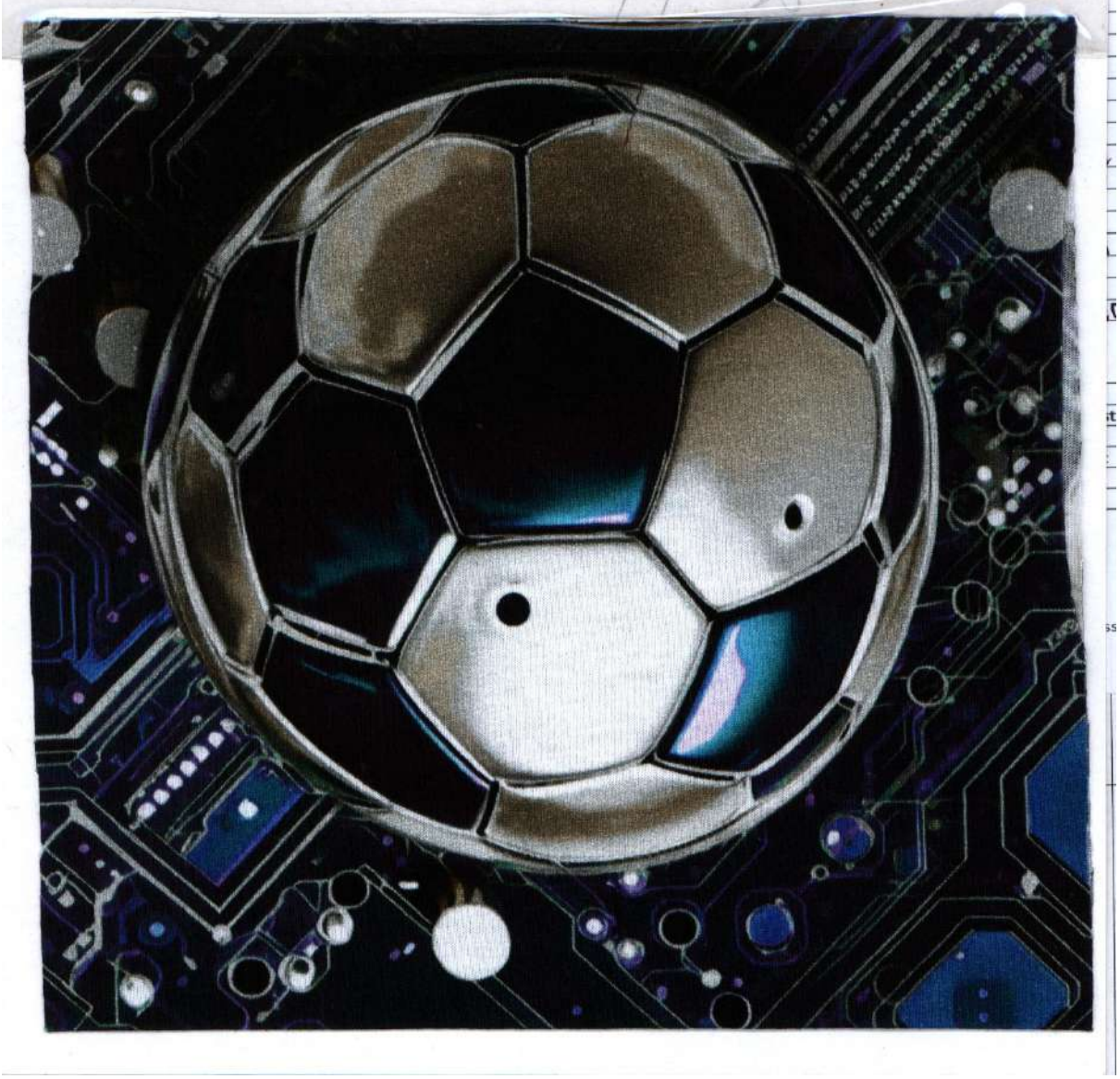
5, bishuya Kuribari, Mirzapur, Gazipur-1700

Quality Assurance- Textile Division

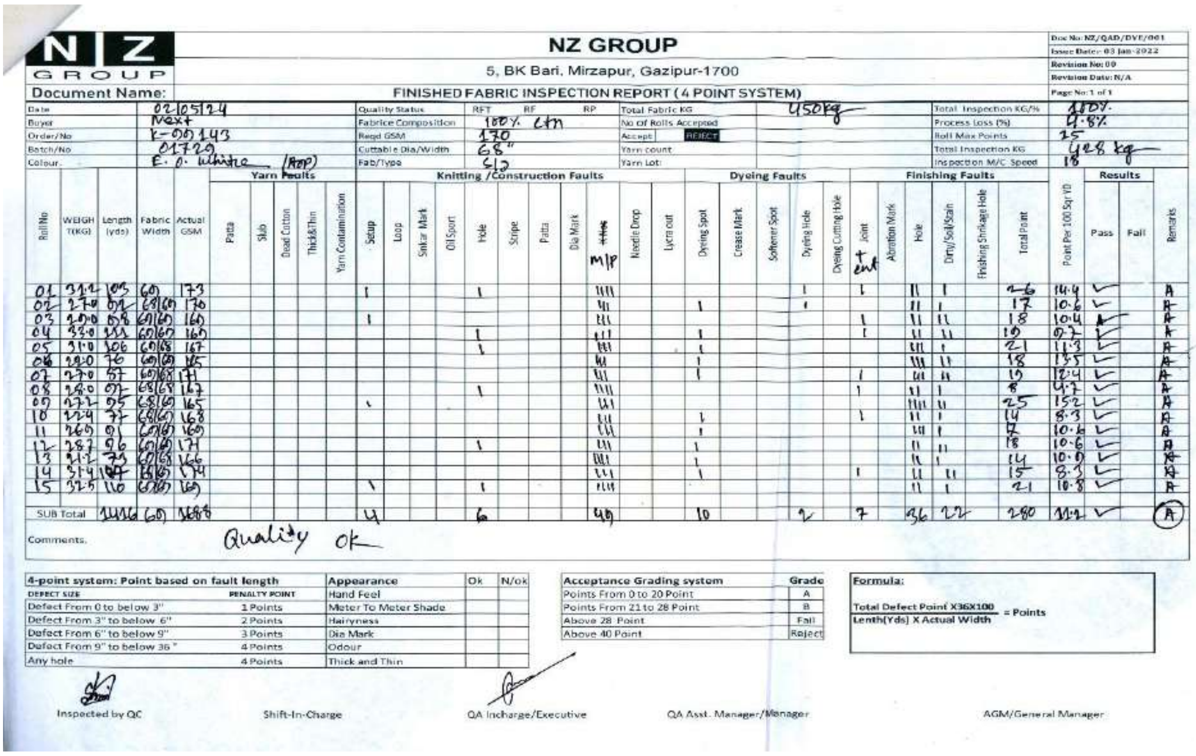
Shade Card

Doc No.:	NZ/QAD/DYE/004
Issue Date:	03 Jan 2022
Rivision No.	00
Rivision Date:	N/A

Buyer Name:	Next			Date:	02/05/24
Order No.	K-09143			Batch Qty:	450kg
P.O/Job No.				Color:	E.O. white (AOP)
Batch No.	01729	Batch SL No.		Req. GSM:	170
Fabric Type:	S/J			Act. GSM:	/ /



Picture-03 after print, finished shade card.



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5, BK Bari, Mirzapur, Gazipur-1700

Document Name: FINISHED FABRIC INSPECTION REPORT (4 POINT SYSTEM)

Doc No: NZ/QAD/DYE/001; Issue Date: 03 Jan 2022; Revision No: 00; Revision Date: N/A; Page No: 1 of 1

Date: 02/05/24; Buyer: Next; Order/No: K-00143; Batch/No: 01729; Colour: E. O. white (AOP)

Quality Status; Fabrice Composition: 100% Ctn; Reqd GSM: 170; Cuttable Dia/Width: 68"; Fab/Type: S/J

Total Fabric KG: 450 kg; Total Inspection KG/%: 100%; Process Loss (%): 4.8%; Roll Max Points: 25; Total Inspection KG: 428 kg; Inspection M/C Speed: 18

SUB Total: 1446, (60), 1683 ... Total Point 280; Point Per 100 Sq YD 11.2; Pass; Remarks (A)

Comments: Quality ok

4-point system: Point based on fault length	Penalty Point
Defect From 0 to below 3"	1 Points
Defect From 3" to below 6"	2 Points
Defect From 6" to below 9"	3 Points
Defect From 9" to below 36"	4 Points
Any hole	4 Points

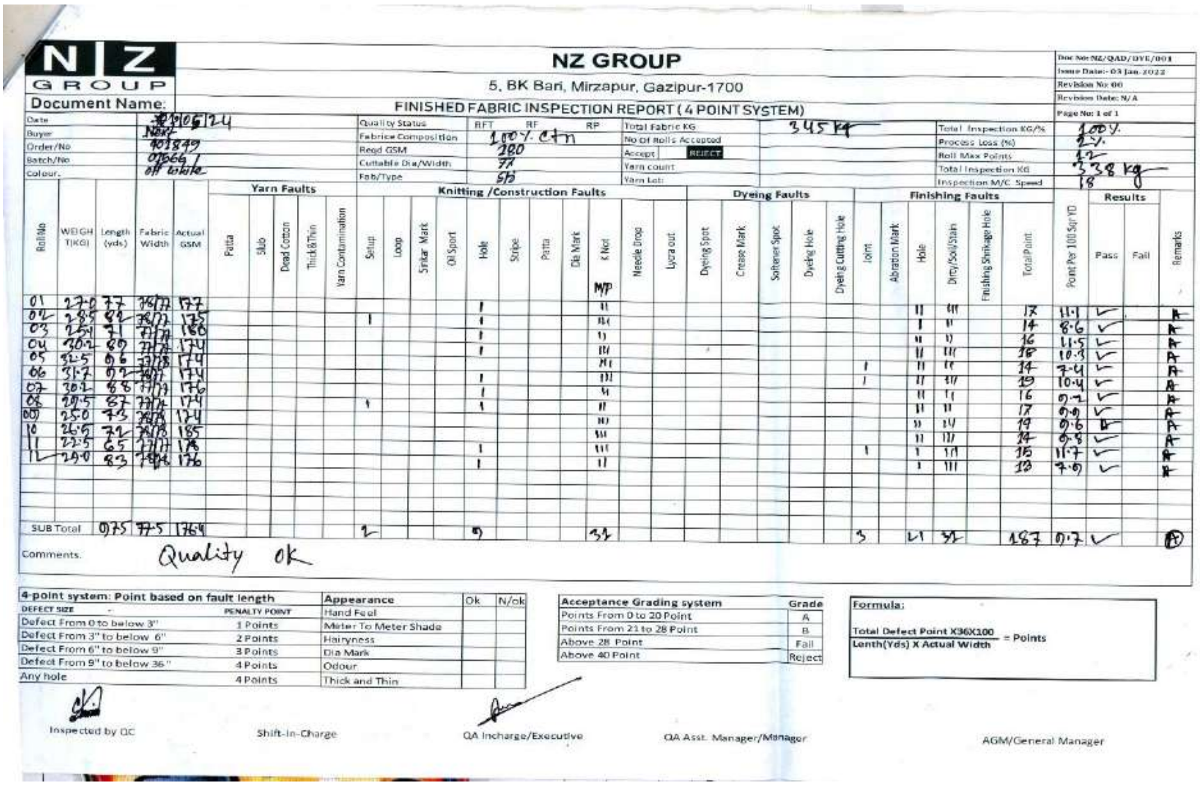
Appearance	Ok	N/ok
Hand Feel		
Meter To Meter Shade		
Hairyness		
Dia Mark		
Odour		
Thick and Thin		

Acceptance Grading system	Grade
Points From 0 to 20 Point	A
Points From 21 to 28 Point	B
Above 28 Point	Fail
Above 40 Point	Reject

Formula: Total Defect Point X36X100 / Lenth(Yds) X Actual Width = Points

Inspected by QC; Shift-In-Charge; QA Incharge/Executive; QA Asst. Manager/Manager; AGM/General Manager

Picture-01 after AOP Inspection Report Prepared by Offline QI.



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5, BK Bari, Mirzapur, Gazipur-1700

Document Name: FINISHED FABRIC INSPECTION REPORT (4 POINT SYSTEM)

Doc No: NZ/QAD/DYE/001; Issue Date: 03 Jan 2022; Revision No: 00; Revision Date: N/A; Page No: 1 of 1

Date: 02/06/24; Buyer: Next; Order/No: 403849; Batch/No: 07666; Colour: off white

Fabrice Composition: 100% Ctn; Reqd GSM: 180; Cuttable Dia/Width: 72; Fab/Type: S/J

Total Fabric KG: 345 kg; Total Inspection KG/%: 100%; Process Loss (%): 2%; Roll Max Points: 12; Total Inspection KG: 338 kg; Inspection M/C Speed: 18

SUB Total: 0175, 77.5, 1764 ... Total Point 187; Point Per 100 Sq YD 9.7; Pass; Remarks (A)

Comments: Quality ok

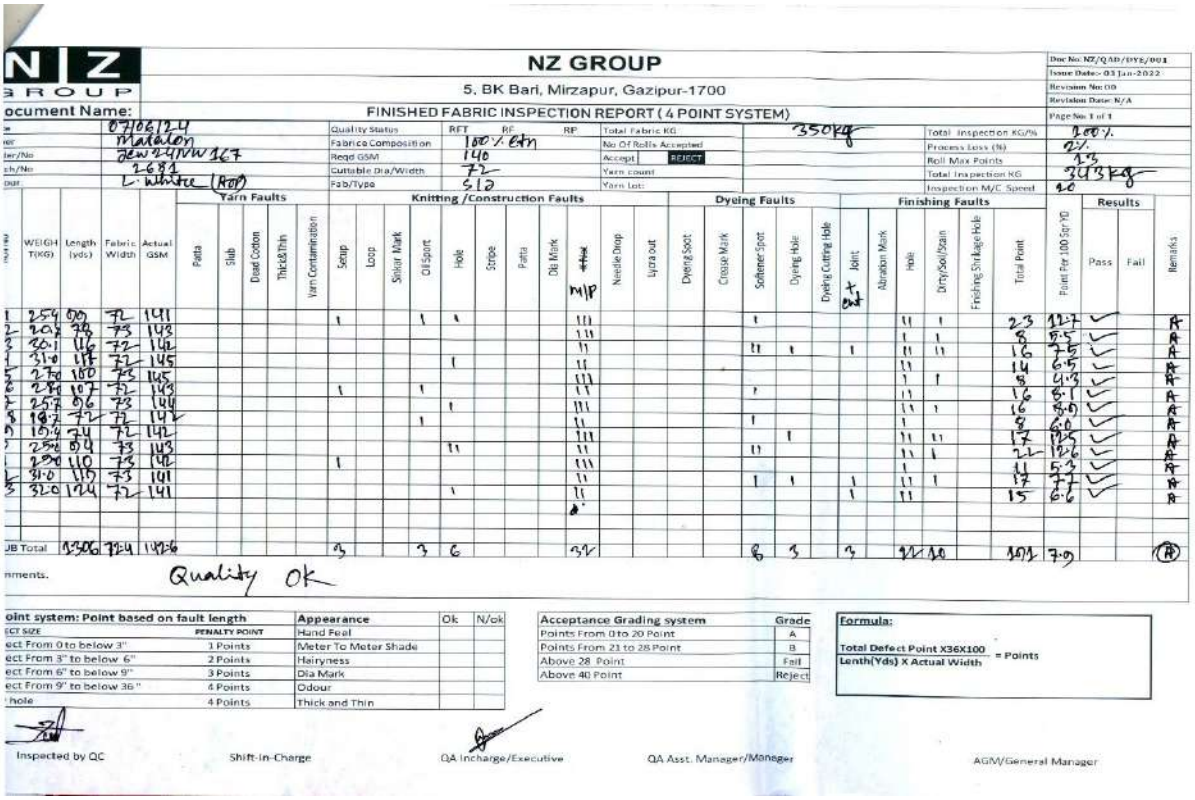
4-point system: Point based on fault length	Penalty Point
Defect From 0 to below 3"	1 Points
Defect From 3" to below 6"	2 Points
Defect From 6" to below 9"	3 Points
Defect From 9" to below 36"	4 Points
Any hole	4 Points

Acceptance Grading system	Grade
Points From 0 to 20 Point	A
Points From 21 to 28 Point	B
Above 28 Point	Fail
Above 40 Point	Reject

Formula: Total Defect Point X36X100 / Lenth(Yds) X Actual Width = Points

Inspected by QC; Shift-In-Charge; QA Incharge/Executive; QA Asst. Manager/Manager; AGM/General Manager

Picture-02 after AOP Inspection Report Prepared by Offline QI.



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5, BK Bari, Mirzapur, Gazipur-1700

FINISHED FABRIC INSPECTION REPORT (4 POINT SYSTEM)

Doc No: NZ/QAD/FPIS/001 | Issue Date:- 03 Jan-2022 | Revision No: 00 | Revision Date: N/A | Page No: 1 of 1

Document Name:

	07106174	Quality Status	RFT RF RP	Total Fabric KG	350kg	Total Inspection KG/%	100%
	Matalon	Fabrice Composition	100% cotn	No Of Rolls Accepted		Process Loss (%)	2%
	2691	Reqd GSM	140	Accept REJECT		Roll Max Points	4.5
	L White (ROD)	Cuttable Dia/Width	72	Yarn count		Total Inspection KG	343kg
		Fab/Type	S12	Yarn Lot:		Inspection M/C Speed	20

Yarn Faults						Knitting /Construction Faults										Dyeing Faults					Finishing Faults					Results		
WEIGH T(KG)	Length (yds)	Fabric Width	Actual GSM	Patta	Slub	Dead Cotton	Thick&Thin	Yarn Contamination	Setup	Loop	Shiliot Mark	Oil Spot	Hole	Stripe	Patta	Dia Mark	MP	Needle Drop	Lycra out	Dyeing Spot	Crease Mark	Softener Spot	Dyeing Hole	Dyeing Cutting Hole	Joint	Abrasion Mark	Hole	Dirty Spot/Stain	Finishing Shrinkage Hole	Total Point	Point Per 100 Sqr YD	Pass	Fail	Remarks
254	90	71	141						1			1	1				111					1					11	1		23	11.7	✓		A
202	98	73	143														111										1	1		8	5.5	✓		A
201	116	72	140														11					11	1		1		11	11		16	7.5	✓		A
310	118	72	145										1				11										11			14	6.5	✓		A
270	100	73	145														111										1	1		8	4.3	✓		A
280	107	72	143						1			1					11					1					11			16	8.1	✓		A
257	96	73	144										1				111										11	1		16	8.0	✓		A
198	72	72	142									1					11					1					1			8	6.0	✓		A
154	74	72	142														111						1				11	11		17	12.5	✓		A
252	104	73	143										11				11					11					11	1		22	12.6	✓		A
290	110	73	141						1								111										1			11	5.3	✓		A
310	110	73	141														11					1	1		1		11	1		17	7.7	✓		A
320	124	72	141										1				11								1		11			15	6.6	✓		A
JB Total	1350	72.4	142.6						3			3	6				32					8	3		3		91	10		301	7.09			(A)

Comments: Quality Ok

Point system: Point based on fault length		Appearance	Ok	N/ok
DEFECT SIZE	PENALTY POINT	Hand Feal		
Defect From 0 to below 3"	1 Points	Meter To Meter Shade		
Defect From 3" to below 6"	2 Points	Hairyness		
Defect From 6" to below 9"	3 Points	Dia Mark		
Defect From 9" to below 36"	4 Points	Odour		
Per hole	4 Points	Thick and Thin		

Acceptance Grading system	Grade
Points From 0 to 20 Point	A
Points From 21 to 28 Point	B
Above 28 Point	Fail
Above 40 Point	Reject

Formula:

Total Defect Point X36X100 / Lenth(Yds) X Actual Width = Points

Inspected by QC | Shift-In-Charge | QA Incharge/Executive | QA Asst. Manager/Manager | AGM/General Manager

Picture-03 after AOP Inspection Report Prepared by Offline QI.

1.15 AOP Problem List:

a) PH = Pinhole
b) MP = Miss Print
c) SCB = Side Color Bleeding
d) SGP = Side Gap Print
e) CS = Color Spot
f) RR = Required Repeat
g) CF = Color Flashing
h) DO = Design Overlapping
i) SO = Setting Out
j) BP = Backside Passing
k) CV = Coverage
l) RM = Repeat Mark
m) C/J = Cut & Joint
n) CH = Chemical Spot
o) DS = Dirty Spot
p) TH = Touching
q) BW = Bowing
r) OS = Oil spot
s) US = Uneven Shade
t) CR = Crease mark
u) HR = Hairy
v) NL = Needle Line
w) CM = Crumple mark
x) DC = Dead Cotton
y) LM = Line Mark
z) NP = Naps
aa) MS=M/C stoppage

bb) BR = Barre Mark
cc) SN = Slanting
dd) IS = Insect Spot
ee) LY = Lycra Out
ff) SN = Slanting.

1.16 AOP Problem Remedies:

- PH = Pinhole:
- MP = Miss Print: Due to screen jam occuring this problem.
- SCB = Side Color Bleeding: Fabric Dia Variation & absorbency up down.
- SGP = Side Gap Print: Print Screen Measurment to Larger Dia Fabrics for this reason Side Gap Print.
- CS = Color Spot:
- RR = Required Repeat:
- CF = Color Flashing:
- DO = Design Overlapping:
- SO = Setting Out:
- BP = Backside Passing:
- CV = Coverage:
- RM = Repeat Mark:
- C/J = Cut & Joint:
- CH = Chemical Spot:
- DS = Dirty Spot:
- TH = Touching:
- BW = Bowing:
- OS = Oil spot:
- US = Uneven Shade:
- CR = Crease mark:
- HR = Hairy:
- NL = Needle Line:
- CM = Crumple mark:
- DC = Dead Cotton:
- LM = Line Mark:
- NP = Naps:
- MS=M/C stoppage:
- BR = Barre Mark:
- SN = Slanting:
- IS = Insect Spot:
- LY = Lycra Out:
- SN = Slanting:

CHAPTER-2

LITERATURE REVIEW

2.1 Literature Review:

Textile All Over Printing (AOP) involves intricate designs covering the entire fabric surface, necessitating thorough testing for quality assurance. Various methods have been developed for testing AOP, including fastness-to-washing tests [1], equipment for efficient printing processes [2], cost-effective effluent treatment processes for textile printing waste management [3], and innovative textile printing technologies for diverse fabric types [4] [5]. These advancements encompass testing the durability of prints after washing, enhancing printing device structures for ease of operation, implementing effective effluent treatment processes, and utilizing versatile printing technologies for different textiles. By integrating these findings, a comprehensive comparative study on different test requirements for AOP can be conducted, considering factors like print durability, operational efficiency, environmental impact, and fabric compatibility to ensure high-quality and sustainable textile printing practices.

CHAPTER-3

EXPERIMENTAL DETAILS

3.1 Order Detials:

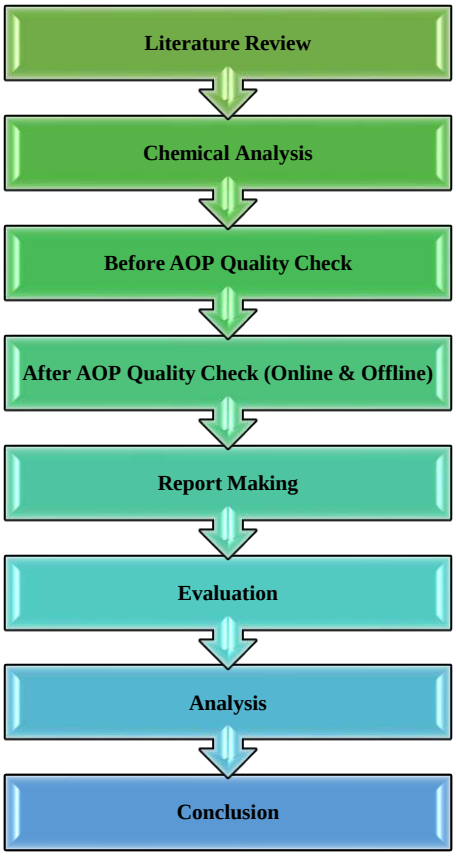
Description of Different Buyer Order						
S.L. No.	Buyer	Order No	Fabrication	Print Type	Color	Remarks
1	Otto (Ernsting Family)	845983	100% Cotton , Slub Jersey,160 GSM	Discharge	275 Pink	
2	Otto (Ernsting Family)	843071	95% Cotton 5% Elastane, Single Jersey,180 GSM	Pigment	11-0602 TCX	
3	Otto (Ernsting Family)	845937	100% Cotton, Single Jersey,160 GSM	Pigment	Snow White	
4	Otto (Ernsting Family)	845934	100% Cotton, single jersey,160 GSM	Discharge	275 Pink	
5	Otto (Ernsting Family)	845896	100% Cotton Single Jersey 160 GSM	Pigment	Snow White	
6	Otto (Ernsting Family)	847294	60% Cotton 40% Polyester, French Terry Inside Brushed, 230 GSM	Discharge	AOP ON HUAFU HC161	
7	Otto (Ernsting Family)	846970	95% Cotton 5% Elastane Slub S/J 180 GSM	Pigment	Snow White	

8	Otto (Ernsting Family)	847002	79% Cotton 21% Polyester, French Terry Inside Brushed,280 GSM	Pigment	16- 5807 TCX Lily Pad	
9	Otto (Ernsting Family)	847295	60% Cotton 40% Polyester French Terry 280 GSM	Pigment	HUAFU VOL.47HB820CY	
10	Otto (Ernsting Family)	849901	95% CMIA Cotton Combed 5% Elastane S/J,160 GSM	Pigment	Snow White	
11	M.Care	JL409	100% COTTON DIAGONAL BRUSH BACK FLEECE, 260 GSM	Discharge	EPSOM AOP	
12	M.Care	JM686	100% COTTON DIAGONAL BRUSH BACK FLEECE, 260 GSM	Pigment	GARDENIA AOP	
13	M.Care	IF558	100% COTTON SINGLE JERSEY 180 GSM	Discharge	HIGH RISK RED AOP	
14	M.Care	JL404	100% COTTON SINGLE JERSEY 180 GSM	Discharge	NAVY BLUE AOP	
15	M.Care	IF636	95% COTTON, 5% ELASTANE, 3X1 LYCRA RIB 220 GSM	Pigment	ORCHID BLOOM AOP	

16	M.Care	IF640	95% COTTON, 5% ELASTANE, 3X1 LYCRA RIB 220 GSM	Discharge	BLUE BONNET AOP	
17	M.Care	IF554	100% COTTON 2x2 RIB 220 GSM	Pigment	KELLY GREEN AOP	
18	M.Care	IF568	100% COTTON SINGLE JERSEY 180 GSM	Discharge	BURNT ORANGE AOP	
19	M.Care	JM434	100% COTTON SINGLE JERSEY 180 GSM	Pigment	CREAM PINK AOP	
20	M.Care	JM434	100% COTTON SINGLE JERSEY 180 GSM	Discharge	ANGEL FALL AOP	
21	Next	B41400	100% BCI COTTON LOOP BACK TERRY 200 GSM	Discharge	ASHFALT AOP	
22	Next	CA-10763	100% BCI COTTON INTERLOCK 200 GSM	Discharge	NAVY	
23	Next	B60361	92% BCI COTTON, 8% ELASTANE, SINGLE JERSEY, 230 GSM	Reactive	CHATEAU GRAY AOP	

24	Next	CA-11215	100% BCI COTTON INTERLOCK 200 GSM	Reactive	OFF WHITE	
25	Next	157468	100% COTTON SINGLE JERSEY 180 GSM	Reactive	EGRET AOP	
26	Next	N96315	100% COTTON SINGLE JERSEY 200 GSM	Reactive	WHITE ASPARAGUS AOP	
27	Next	Q96812	100% COTTON SINGLE JERSEY 180 GSM	Reactive	BROWN RICE AOP	
28	Next	CA-264	100% COTTON INTERLOCK, 200 GSM	Reactive	WHITE AOP	
29	Next	: CA-265	100% COTTON INTERLOCK, 200 GSM	Discharge	17-40216 TCX	
30	Next	CA-263	100% COTTON INTERLOCK, 200 GSM	Reactive	SNOW WHITE	

3.2 Process Flow Chart:



3.3 Required Test of the Buyer's:

List of buyer's required test				
SL. No.	**List of AOP Test**	**Otto**	**M.Care**	**Next**
1	Dimension Stability After Wash (ISO 3759, 5077, 6330 & AATC135 179 Modified)	✓	✓	✓
2	Fabric Weight (ISO 381, ASTM D3776)	✓	✓	✓
3	Pilling Resistance (ISO 12945 1&2, ASTM D3512),	✓	✓	✓
4	Fabric pH (ISO 3071, AATC 81)	×	✓	✓
5	Bursting Strength of Fabric (ISO 13938-2, ASTM D3786)	×	×	✓
6	Stretch & Recovery (ASTM D3107, ISO 14704)	×	×	×
7	Fabric Composition (AATC 22A, 20 A, ISO 1833)	✓	×	✓
8	Saliva (GB/T 18886) For Baby Department.	×	✓	×
9	CF to Wash (ISO 105 C6 AATC 61)	✓	×	✓
10	CF to Water (ISO 105 E01, AATC 107)	✓	×	✓
11	CF to Perspiration (ISO 105 E04, AATC 15)	✓	✓	×
12	CF to Rubbing (ISO 105 X12, AATC 8)	✓	✓	✓
13	CF to Phenolic Yellowish (ISO 105 X18)	×	×	×
14	CF to Light (ISO 105 B02, AATC 16.3)	✓	×	×
15	Oxidative Bleach Damage.	×	×	×
16	Formaldehyde	✓	×	×
17	Print Durability	×	×	✓
11	Spirality	×	×	✓

3.4 Testing Result Summary:

Dimension Stability After Wash (ISO 3759, 5077, 6330 & AATC135 179 Modified)							
SL	**Otto**	**Req:**	**M.Care**	**Req:**	**Next**	**Req:**	**Remarks**
1	L: -2.00 W: -2.60 SP:0.50%	L:±5 W: ±5 SP: 5%	L: -2.5 W: -4.0 SP: 3.0	L: -8% to +2% W: -6% to +2% SP: MAX 5%	L: -5.8 W:-2.8 SP: 2.0%	L: 0 TO -6 W: 0 TO -6 SP: 5.0%	
2	L: -3.00 W: -1.00 SP:0.50%		L: -5.8 W: +0.6 SP:3.5		L: -2.3 W: -1.0 SP: 0.5%		
3	L: -4.00 W: 0.00 SP:0.00%		L:-1.5 W:-4.0 SP:0.5		L: -3.6 W: -4.9 SP: 0.5%		
4	L: -1.00 W: -1.00 SP:0.00%		L: -0.5 W:-1.5 SP:0.5		L: -3.8 W:-0.6 SP: 1.0%		
5	L: -3.00 W: -1.00 SP:0.00%		L:-2.6 W:-6.4 SP:0.5		L: 4.2 W:-2.3 SP: 0.5%		
6	L: -1.30 W: -1.60 SP:0.00%		L: -1.3 W:-7.2 SP:0.5		L:-3.8 W: -3.3 SP: 0.5%		
7	L: -2.00 W: -2.60 SP:0.00%		L:-4.2 W:-6.6 SP:0.5		L:-5.8 W:-2.0 SP: 0.5%		
8	L: -2.00 W: -2.60 SP:0.50%		L:-1.5 W:-2.3 SP:0.5		L:-5.8 W:-2.5 SP: 0.5%		
9	L: -2.00 W: -0.30 SP:0.00%		L:-2.5 W:-2.5 SP:1.0		L: -5.5 W: -3.3 SP: 0.5%		
10	L: -1.50 W: -1.00 SP:0.00%		L:-2.5 W:-1.6 SP:0.5		L:-5.8 W:-0.6 SP: 0.5%		

Fabric Weight (ISO 381, ASTM D3776)					
SL	**Otto**	**M.Care**	**Next**	**Req:**	**Remarks**
1	181	264	268	±5	
2	148	269	192		
3	147	189	240		
4	159	186	191		
5	172	219	187		
6	177	217	210		
7	177	221	180		
8	179	178	201		
9	156	174	201		
10	158	185	205		

Pilling Resistance (ISO 12945 1&2, ASTM D3512)						
SL	**Otto**	**M.Care**	**Req:**	**Next**	**Req:**	**Remarks**
1	X	4-5	4-5	4	4	
2	X	4-5		4		
3	X	3-4		4		
4	X	4-5		4		
5	X	4-5		4		
6	X	3-4		3		
7	X	2-3		2		
8	X	4-5		4		
9	X	4-5		3		
10	X	4-5		4		

Fabric pH (ISO 3071, AATC 81)				
SL	**Otto**	**M.Care**	**Next**	**Remarks**
1	X	6.6	5.5	
2	X	4.5	6.1	
3	X	5.5	5.5	
4	X	6	4.5	
5	X	3.4	3.4	
6	X	2.3	5.5	
7	X	4.5	6.6	
8	X	5.4	2.3	
9	X	6	3.4	
10	X	4.4	5.5	

Bursting Strength of Fabric (ISO 13938-2, ASTM D3786)					
SL	Otto	M.Care	Next [KPA]	Req:	Remarks
1	X	X	376.00	250.00 KPA	
2	X	X	308.00		
3	X	X	324.00		
4	X	X	300.00		
5	X	X	270.00		
6	X	X	310.00		
7	X	X	290.00		
8	X	X	340.00		
9	X	X	350.00		
10	X	X	350.00		

Stretch & Recovery (ASTM D3107, ISO 14704)				
SL	Otto	M.Care	Next	Remarks
1	X	X	X	
2	X	X	X	
3	X	X	X	
4	X	X	X	
5	X	X	X	
6	X	X	X	
7	X	X	X	
8	X	X	X	
9	X	X	X	
10	X	X	X	

Fabric Composition (AATC 22A, 20 A, ISO 1833)				
SL	Otto	M.Care	Next	Remarks
1	Cotton	X	Cotton	
2	Cotton/Elastane	X	Cotton	
3	Cotton	X	Cotton/Elastane	
4	Cotton	X	Cotton	
5	Cotton	X	Cotton	
6	Cotton/Polyester	X	Cotton	
7	Cotton/Elastane	X	Cotton	
8	Cotton/Polyester	X	Cotton	
9	Cotton/Polyester	X	Cotton	
10	Cotton/Elastane	X	Cotton	

Saliva (GB/T 18886) For Baby Department.					
SL	**Otto**	**M.Care**	**Req:**	**Next**	**Remarks**
1	X	4-5	4-5	X	
2	X	4-5		X	
3	X	3-4		X	
4	X	4-5		X	
5	X	4-5		X	
6	X	3-4		X	
7	X	2-3		X	
8	X	4-5		X	
9	X	4-5		X	
10	X	4-5		X	

CF to Wash..... (ISO 105 C6 AATC 61)				
SL	**Otto**	**M.Care**	**Next**	**Remarks**
1	4-5	4-5	4-5	
2	4-5	3-4	4-5	
3	3-4	3-4	4-5	
4	4-5	4-5	4-5	
5	4-5	4-5	4-5	
6	3-4	3-4	3-4	
7	2-3	3-4	3-4	
8	4-5	4-5	4-5	
9	4-5	4-5	3-4	
10	4-5	4-5	4-5	

CF to Water..... (ISO 105 E01, AATC 107)							
SL	**Otto**	**Req:**	**M.Care**	**Req:**	**Next**	**Req:**	**Remarks**
1	4-5	4	4-5	4-5	4-5	4	
2	4-5		4-5		3-4		
3	3-4		4-5		3-4		
4	4-5		4-5		4-5		
5	4-5		4-5		4-5		
6	3-4		3-4		3-4		
7	2-3		3-4		3-4		
8	4-5		4-5		4-5		
9	4-5		3-4		4-5		
10	4-5		4-5		4-5		

CF to Perspiration (ISO 105 E04, AATC 15)					
SL	**Otto**	**M.Care**	**Req:**	**Next**	**Remarks**
1	X	4-5	4-5	X	
2	X	3-4		X	
3	X	3-4		X	
4	X	4-5		X	
5	X	4-5		X	
6	X	3-4		X	
7	X	3-4		X	
8	X	4-5		X	
9	X	4-5		X	
10	X	4-5		X	

CF to Rubbing (ISO 105 X12, AATC 8)							
SL	**Otto**	**Req:**	**M.Care**	**Req:**	**Next**	**Req:**	**Remarks**
1	4-5	4-5	4	4	4-5	4-5	
2	3-4		3		3-4		
3	3-4		4		3-4		
4	2-3		3		4-5		
5	4-5		3		4-5		
6	4-5		4		2-3		
7	3-4		4		3-4		
8	4-5		3		3-4		
9	4-5		3		4-5		
10	4-5		3		4-5		

CF to Phenolic Yellowish (ISO 105 X18)				
SL	**Otto**	**M.Care**	**Next**	**Remarks**
1	X	X	X	
2	X	X	X	
3	X	X	X	
4	X	X	X	
5	X	X	X	
6	X	X	X	
7	X	X	X	
8	X	X	X	
9	X	X	X	
10	X	X	X	

CF to Light(ISO 105 B02, AATC 16.3)				
SL	**Otto**	**M.Care**	**Next**	**Remarks**
1	X	X	X	
2	X	X	X	
3	X	X	X	
4	X	X	X	
5	X	X	X	
6	X	X	X	
7	X	X	X	
8	X	X	X	
9	X	X	X	
10	X	X	X	

Oxidative Bleach Damage.				
SL	**Otto**	**M.Care**	**Next**	**Remarks**
1	X	X	X	
2	X	X	X	
3	X	X	X	
4	X	X	X	
5	X	X	X	
6	X	X	X	
7	X	X	X	
8	X	X	X	
9	X	X	X	
10	X	X	X	

Formaldehyde				
SL	**Otto**	**M.Care**	**Next**	**Remarks**
1	Not Deceted	X	X	
2	Not Deceted	X	X	
3	Not Deceted	X	X	
4	Not Deceted	X	X	
5	Not Deceted	X	X	
6	Not Deceted	X	X	
7	Not Deceted	X	X	
8	Not Deceted	X	X	
9	Not Deceted	X	X	
10	Not Deceted	X	X	

Print Durability				
SL	**Otto**	**M.Care**	**Next**	**Remarks**
1	X	X	Satisfactory.	
2	X	X	Satisfactory.	
3	X	X	Satisfactory.	
4	X	X	Satisfactory.	
5	X	X	Satisfactory.	
6	X	X	Satisfactory.	
7	X	X	Satisfactory.	
8	X	X	Satisfactory.	
9	X	X	Satisfactory.	
10	X	X	Satisfactory.	

Spirality				
SL	**Otto**	**M.Care**	**Next**	**Remarks**
1	X	X	X	
2	X	X	X	
3	X	X	X	
4	X	X	X	
5	X	X	X	
6	X	X	X	
7	X	X	X	
8	X	X	X	
9	X	X	X	
10	X	X	X	

3.5 Artwork & Garments Picture:

CHAPTER-4

DISCUSSION OF RESULTS

4.1 Discussion of Result:

1. **Pigment AOP:**

- **Color Fastness:** Pigments don't chemically bond with fibers but are attached using binders. Consequently, pigment AOP typically has lower color fastness to washing and rubbing compared to dyes.
- **Advantages:** This method is cost-effective and suitable for various fabric types.
- **Challenges:** Pigment prints may fade or lose color intensity with repeated washing and exposure to sunlight.

2. **Discharge AOP:**

- **Color Fastness:** Discharge printing uses chemicals to remove the dye from specific fabric areas, creating designs by discharging color. This results in excellent color fastness because the discharged areas are typically bare fabric or printed with other stable dyes.
- **Advantages:** Achieves vibrant colors on dark fabrics without extra dye layers, ensuring smooth, breathable prints.
- **Challenges:** Works best on fabrics dyed with dischargeable dyes (mostly natural fibers like cotton). Requires precise control to prevent uneven discharge.
- 3. **Reactive AOP:**
- Color Fastness: Reactive dyes form a chemical bond with the fabric, resulting in high color fastness to washing, light, and perspiration. Reactive AOP is particularly durable on cotton and cellulose fibers.
- Advantages: Provides bright, wash-resistant colors and is widely used for high-quality garments.
- Challenges: Requires specific conditions (alkaline environment, heat) for fixation, making the process slightly more complex and time-consuming.
-

AOP Type	**Color Fastness to Washing**	**Color Fastness to Rubbing**	**Application Suitability**
Pigment AOP	Moderate to Good	Moderate	Versatile, cost-effective
Discharge AOP	Good	Good	Dark fabrics with dischargeable dyes
Reactive AOP	Excellent	Excellent	High-quality, durable garments

1. Washing Fastness

- **Pigment AOP:** Average rating of 3.5 on the gray scale (1-5 scale), indicating moderate color change and staining after washing.
- **Discharge AOP:** Average rating of 4, showing slightly better washing fastness than pigment, with minimal color staining on adjacent fabrics.
- **Reactive AOP:** Average rating of 4.5, demonstrating excellent washing fastness due to chemical bonding between dye and fabric, resulting in high durability.

2. Rubbing Fastness:

- **Pigment AOP:** Rating of 3 for dry rubbing and 2.5 for wet rubbing, showing lower fastness to rubbing due to the binder-based attachment of pigments, which may wear off during use.

- **Discharge AOP:** Rating of 4 for both dry and wet rubbing, as the fabric remains nearly intact after printing and does not rely on surface binders.
- **Reactive AOP:** Rating of 4.5 for both dry and wet rubbing, displaying excellent fastness, as reactive dyes chemically bond to fibers.

3. Light Fastness

- **Pigment AOP:** Rating of 3.5 on the blue wool scale (1-8 scale), showing moderate resistance to fading under light exposure.
- **Discharge AOP:** Rating of 4, providing better stability to light exposure compared to pigment prints.
- **Reactive AOP:** Rating of 5, indicating the highest resistance to fading, suitable for fabrics exposed to outdoor or high-light environments.

Comparison Data and Analysis Pigment AOP, Discharge AOP, & Reactive AOP:

The table below summarizes the results of the tests with values indicating fastness performance.

AOP Type	Washing Fastness (Gray Scale)	Rubbing Fastness (Dry/Wet)	Light Fastness (Blue Wool Scale)
Pigment AOP	3.5	3.0 / 2.5	3.5
Discharge AOP	4.0	4.0 / 4.0	4.0
Reactive AOP	4.5	4.5 / 4.5	5.0

To further quantify the differences, let's calculate the percentage improvement in fastness ratings between each method compared to Pigment AOP:

Washing Fastness:

Discharge AOP shows a 14.3% improvement over Pigment AOP.

Reactive AOP shows a 28.6% improvement over Pigment AOP.

Rubbing Fastness (Dry):

Discharge AOP shows a 33.3% improvement over Pigment AOP.

Reactive AOP shows a 50% improvement over Pigment AOP.

Light Fastness:

Discharge AOP shows a 14.3% improvement over Pigment AOP.

Reactive AOP shows a 42.9% improvement over Pigment AOP.

Discussion:

The analysis reveals that **Reactive AOP** consistently outperforms **Pigment and Discharge AOP** in terms of color fastness, especially for washing and light exposure, making it ideal for applications where high durability is essential. **Discharge AOP** provides better color clarity and moderate durability, especially suitable for prints on dark fabrics. **Pigment AOP**, while cost-effective, has lower fastness ratings, which may be acceptable for low-wash frequency items.

CHAPTER-5

CONCLUSION

5.1 Conclusion:

The comparative study on different test requirements for All Over Printing (AOP) highlights several critical insights into the performance, quality, and reliability of AOP fabrics. Through a systematic analysis of various testing methodologies, the following conclusions have been drawn:

1. **Color Fastness**: The color fastness tests, including washing, rubbing, and light exposure, demonstrate that the quality of dyes and printing techniques significantly impact the longevity and appearance of AOP fabrics. Fabrics with higher-quality dyes and advanced printing technologies show better color retention.
2. **Dimensional Stability**: Testing for shrinkage and dimensional stability under different conditions reveals that pre-treatment processes and fabric compositions play vital roles. Fabrics that undergo comprehensive pre-treatment processes tend to maintain their dimensions better after multiple washes.
3. **Print Quality and Uniformity**: Evaluations of print sharpness, color uniformity, and defect presence underscore the importance of precision in the printing process. Advanced digital printing technologies generally produce superior results in terms of detail and consistency.
4. **Durability**: The tensile strength and abrasion resistance tests indicate that fabric durability is highly dependent on both the type of material and the quality of the printing process. Synthetic blends often outperform natural fibers in these tests, though advancements in treatment processes can enhance the durability of natural fabrics.
5. **Cost and Efficiency**: While advanced printing technologies and high-quality materials generally result in better performance, they also come at a higher cost. Balancing cost efficiency with quality requirements is crucial for manufacturers to remain competitive.

In conclusion, the comprehensive testing and analysis of AOP fabrics provide valuable insights into optimizing the printing process and material selection to achieve the best possible outcomes in terms of quality, durability, and sustainability. Continued innovation and adherence to stringent testing standards will be essential for advancing the field of textile printing and meeting the evolving demands of the market.

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