UGC & Govt. Approved
Sonargaon University (SU)
সোনারগাঁও ইউনিভার্সিটি (এসইউ)
WE WILL RISE UP WE WILL SHINE

Faculty of Engineering
Department of Textile Engineering

REPORT ON

Industrial Attachment

AT

RATOOL APPARELS LTD.

Address: Vangnahati, Sreepur, Gazipur.

Course Title: Industrial Attachment
Course Code: Tex-442.
13A, Fall- 2021

Submitted By:

Submitted By:	ID Number	Group (AM)
Md. Mostafizur Rahman	TEX1801013050	(B)
Md. Yousuf Hossain Fahim	TEX1801013130	(C)
Md. Sagor Ahmad	TEX1801013070	(B)

Academic Supervised

Kamrul Hassan Bhuiyan
Coordinator & Lecturer

Department of Textile Engineering Sonargaon University (SU). 146 Mohakhali, Wireless Gate. Dhaka.

This report we have presented in partial fulfillment of the requirement for the Degree of Bachelor of Science in Textile Engineering.

Advance in Apparel Manufacturing Technology
Duration: From 01 September 2021 to 30 November 2021.

DECLARATION

We hereby declare that, this Industrial Attachment on **Apprel Manufacturing, of Ratool Apprels ltd.** is done by us under the supervision of **Kamrul Hassan Bhuiyan, Coordinator & Lecturer,** Department of Textile Engineering, **Sonargoan University (SU),** Dhaka. We also declare that, this Industrial Attachment report has not been submitted anywhere for award, degree or diploma. We ensure that, any part of this attachment has been presented anywhere.

_____

Md. Mostafizur Rahman
TEX1801013050

_____

Md. Yousuf Hossain Fahim
TEX1801013130

_____

Md. Sagor Ahmad
TEX1801013070

UGC & Govt. Approved
Sonargaon University (SU)
সোনারগাঁও ইউনিভার্সিটি (এসইউ)
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Permission of industrial Trainin

147/I, Green Road, Panthapath, Dhaka

Department of Textile Engineering

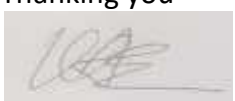
SU/Textile/Int. Letter/2021/Fall/13
Date: 25/08/2021
To
Manager (knitting)
Ratool apparel ltd
Anser Road, Vagnahati, Sreepur, Gazipur

Subject: Request for permission to undertake industrial training in your industry.

Dear Sir,
It is for your kind information that, Sonargaon University (SU) is a private University approved by the Ministry of Education (MOE), & UGC of Bangladesh.
The student(s) named below with the Identification Number is very close to complete 4 years B.Sc in Textile Engineering of Sonargaon University (SU).
As industrial training is one of the important core courses of 4 years B.Sc in Textile Engineering program, therefore the university seeks your kind help and cooperation in order to impart practical knowledge to our students. Duration of this program would be 12 weeks and it is advised to accommodate the students at your production unit from 01 September, 2021.

SL No.	Student Name	Specialized	Student ID	Contact No.
01	Md.Mostafizur Rahman	Apparel Manufacturing	TEX.1801013050	01305099565
02	Md. Sagor Ahmad	Apparel Manufacturing	TEX.1801013070	01771327748
03	Md.Yousuf Hossain Fahim	Apparel Manufacturing	TEX.1801013130	01689620556

Therefore, I am requesting you to provide them with opportunity to conduct the industrial training in your well reputed industry. It will also be highly appreciated if you kindly consider them for training in your Industry.
Your Co-operation will be highly appreciated.
Thanking you



Kamrul Hassan Bhuiyan
Coordinator
Department Of Textile Engineering, Sonargaon University SU
Cell Phone: 01955-529892
Copy to: For necessary information:
1. Dean, Faculty of Engineering, Sonargaon University (SU).
2. Office Copy.

LETTER OF APPROVAL

This is to certify that **Md. Abdul Latif-Tex1801013134, Md. Mamunur Rashid-Tex1801013009, Mst. Eity Ara-Tex1801013102, Mst. Sarmin Akter-Tex1801013103, Md. Al-Amin-Tex1801013153,** BSC Engineering Textile program, 13B Batch have successfully completed their Industrial Internship on Apparel Manufacturing Technology under my supervision. I do hereby approve their report. I also recommend accepting their report for partial fulfillment of Bachelor of Science in Textile Engineering (BSCTE) Degree.

.....

Kamrul Hassan Bhuiyan
Coordinator & Lecturer

Department of Textile Engineering

Sonargaon University (SU), Dhaka

ACKNOWLEDGEMENTS

All pleasure goes to the Almighty Allah who has given me the ability and strength to complete this project.

I am grateful to" **Kamrul Hassan Bhuiyan" Coordinator & Lecturer** of Sonargaon University (SU), Dhaka. Textile Engineering my Academic Supervisor. As well as to "**Md. Atiqur Rahman'' Head of HR, Admin & Complince** of my factory supervisor of **Ratool Apprels ltd**.

Being working with them I have not only earned valuable knowledge but was also inspired by their innovativeness which helped to enrich my experience to a greater extent. Their ideas and way of working was truly remarkable. I believe this report could not be finished if they did not help me continuously.

I would like to thanks the Chairman, General Manager, Production Manager, Sample Manager, Finishing Manager, Washing Manage, Maintenance Manager, Quality control Manager, Factory Manager & Costing Sr. Manager of Standard Group. Who has given us scope for doing industrial attachment in the factory as well as for giving scope to work in their respective section. We also would like to thanks to production **Md. Atiqur Rahman (Head of HR, Admin & Complince) , Knitting Manager Md. Basar and with others persons"** for their proper management & taking necessary procedure about our industrial attachment.

I am also very much grateful to **Ratool Apprels ltd**. Authority/ Management for giving me opportunity to do my internship work in their factory. Last but not the least, thanks go to all the workers, supervisors, Line Chife and Floor in charge who have assisted, helped and inspired me to complete this task at various stages.

ABSTRACT

For any technical education, practical experience is almost equal important in association with the theoretical knowledge. By means of practical knowledge it's not possible to apply the theoretical knowledge in the practical field.

Industrial attachment is the first step to professional life of student, especially of technical side. It's an indispensable part of study a practically running processing technology of an industrial unit for a student. University education provides us vast theoretical knowledge as well as more practical attachment, in despite of all these industrial attachment helps us to be familiar with technical support of modern machinery and skills about various processing stages.

This internship provides me sufficient practical knowledge about production management, efficiency, industrial management, pattern, cutting, sampling, washing, Finishing, Costing, purchasing, inventory control, utility and maintenance of machineries and their operation techniques etc. which cannot be achieved successfully by means of theoretical knowledge only.

We were able to study on their different sections and their activities practically. Due to some limitation of the factory, we have found store section, cutting section, sewing section, finishing section and maintenance section, costing section washing section. Here we have also found the sample section but this section isn't fully operational as here only the Development sample, size set and production samples are produced.

All the activities of this factory are performed according to the central orders of the company. This company works for Academy buyer and sometimes works for Pritha which is an own buying house of this group of company.

During my internship we got the opportunity to study on some orders, from order receive to the delivery of the order. With the help of my supervisor we have acquired the knowledge of handling an order, the production procedure and the inspection procedure to maintain the quality of these orders. We have also learnt about the office management of this factory.

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CHAPTER-01

EXECUTIVE SUMMARY

1. Executive Summary:

Industrial Training is an essential part in developing the practical and professional skills required for an Engineer and an aid to prospective employees. Our internship was carried at **Ratool Apprels ltd**. It is a comprehensive manufacturing and exporting company of Bangladesh. It has independent, sample section, cutting, sewing, finishing section, washing section, ETP, compliance, Utility & Costing section etc.

In this report we have mainly described about the Garments section of the" The Civil Engineers Limited, Standard Group". As it is a washing factory we fortunately took the opportunity to learn about other important department of the factory too like Sample Department, Garments Department, Merchandising Department, Costing Department, Quality Department, and IE &Planning Department. Sample section is used to make development samples. Sample helps the factory to get a new order for different styles. We also learnt about different samples like development samples, quotation Samples, size-set sample, counter samples, production samples. We tried to have some practical knowledge about CAD and their importance for making pattern, marker and so on.

CHAPTER-02

INFORMATION ABOUT OF FACTORY

2.History of the Factory:

SISTER CONCERN of RODDUR APPARELS LTD UNIT-1, RODDUR APPARELS LTD UNIT-2

100% Export Oriented Knit Garments Industry

HEAD OFFICE

ADDRESS: House- 288, Road-04, 1st floor, Baridhara DOHS, Dhaka Bangladesh
CONTACT: +880 1713046497
MAIL: hossain@ratoolapparels.com

FACTORY:
RATOOL APPARELS LTD.
ADDRESS: Vangnahati Sreepur, Gazipur
CONTACT: +880 1713046497
E-MAIL: hossain@ratoolapparels.com
RODDUR APPARELS LTD. UNIR-1
Hariken Road, Gazipur
RODDUR APPARELS LTD. UNIR-2
Hariken Road, Gazipur

ABOUT US

Ratool Apparel Limited is fully compliant knit fabrics and garments manufacturing and exporting firm located in

Sreepur, Gazipur, Bangladesh including another TWO UNITS (RODDUR APPARELS LTD. UNIR-1, RODDUR APPARELS LTD. UNIR-2). Our product range including basic and fashion T-shirt, Polo shirt, Legging, Sports-wear, Sleeping-suits, Boxers, Slips etc for Children (Kids & Babies) Women and Men.

The factory is housed in appropriately designed buildings certified to be suitable used as garments manufacturing unit. The building is equipped with necessary structural and fire safety measures required to grow a healthy and fulfilling garments manufacturing environment.

The production floor consists of knitting and garments department. It is equipped with circular knitting machine, Swing Machine, complete CAD, CAM for automatic laying, cutting and pattern making and other textiles machineries. All of the machines are state of the art and have European based origin. Our fabric production capacity is more than 4,500 Tons per year and garments unit production capacity is 16.4 million pieces per year.

At Ratool, we believe that our success resides in valuing our individual customer satisfaction as the topmost priority based on the following cornerstones:

- High quality products.
- On-time shipment.
- Efficient service.

To achieve these we place great emphasis on giving special customized attention to each of our client to accurately determine their individual requirements.

In Ratool, we believe that successful management for any operation requires efficiency, administrative ability and dedication. Our management team is designed and held together with strong root and consists of vast experience in various similar industries which involves co-ordination of people and work process management.

Our people are our biggest asset, as their expertise allows us to serve our buyers effectively and with great inspiration. As a result we always give priority in maintaining a balanced and fulfilling relation between the management team and the workers.

We, at Ratool, pride ourselves as a socially as well as environmentally responsible organization. We aim to achieve sustainable environment through our initiatives to reduce water and carbon consumption.

We are organized by our customer and suppliers as a trustworthy organization. We are striving to deliver high quality products and efficient services. With the combined efforts of our well-practiced management, experienced technicians, skilled workers and highly professional marketing team, we have seen our company growing rapidly over the past years.

PRODUCTION FACILITIES

The production facility is divided in four different sections and an additional utility facility to support them:

KNITTING SECTION

Available Machines:	9 circular Knitting Machine;	**Brand:** LISKY TAIWAN
	All the machines have Full Feeder Lycra attachment with Lycra feeding units from Memminger, Germany	
Production Capacity:	**2.5 Tons per day**	
Fabric:	Single Jersey(LY), Pique French Terry, Yarn-Dye Stripe, Gros breaker needle.	

Available Machines: **Cutting Floor:**

- Automatic Spreader 08 Pcs; **BRAND: MAC, Japan**
  - Fabric Relax Machine: Winda, China
  - Fabric Inspection Machine: UZU Brand, Thailand.

Production Capacity: 35,000 Pcs/Day

Production Capacity:

Garments/ Fabric Produced:

Sewing Floor:

- 240 sewing machines (10 lines x 24 m/c per line);

  BRAND: Jhuki, Brother,Pegasus, Japan (machines selection is such to cover most of the stitching facilities for the knit garments)

  Siruba (China).

Finishing Floor:

- Thread sucking machines 8 nos ,
- Full Steam Iron with vacuum table 18 nos.
- Automatic metal detector machine Brand Lock, UK.

4 floor, 35,000 pcs per day i.e. 8,75,000 **pcs per month.**

T-shirt, Polo-shirt, Sport wear, Legging, Jogging set, Hoody, Nightwear set, Sweat, Fleece Jacket

T-shirt set, all kinds of basic and fashionable teams for Children (kids and babies),

Ladies and Men.

Cotton/Elastin, Mélange, y/d stripe of cotton, viscose, polyester, CVC, PC, Pique.

GARMENTS SECTION RODDUR APPARELS LTD. UNIT-2

Available Machines:

Sewing Floor:

- 200 sewing machines (8 lines x 24 m/c per line);

BRAND: Jhuki, Brother,Pegasus, Japan (machines selection is such to cover most of the stitching facilities for the knit garments)

Siruba (China).

Finishing Floor:

- Thread sucking machines 8 nos ,
- Full Steam Iron with vacuum table 18 nos.
- Automatic metal detector machine Brand Lock, UK.

Production Capacity:

Garments/ Fabric Produced:

1 floor, 25,000 pcs per day i.e. 6250000 **pcs per month.** T-shirt, Polo-shirt, Sport wear, Legging, Jogging set, Hoody, Nightwear set, Sweat, Fleece Jacket T-shirt set, all kinds of basic and fashionable teams for Children (kids and babies), Ladies and Men.

Cotton/Elastin, Mélange, y/d stripe of cotton, viscose, polyester, CVC, PC, Pique.

COMPLIANCE ISSUES

Being a socially as well as environmentally responsible organization, we are very conscious regarding the well-being of our workers and the environment in which they reside. To ensure this we maintain the following policies and measures. These are broadly categorized under the following four broad sections:

ETHICAL AND SOCIAL MEASURE:

- ☐ All rules and regulation regarding workers' salary, benefit and appointments are maintained according to **Bangladesh Labor Law**.
- ☐ Workers' Participation and Welfare Fund (WPF) is established
- ☐ Fully computerized **attendance card** is maintained.
- ☐ **Protective equipment's** like masks, ear plugs, goggles, glass, boots etc are used on a production **floor** and store area as required. Signs and warnings are also posted on required re s to remind workers to wear protective equipment's.
- ☐ Entire factory facility is declared and maintained as **non-smoking zone**.
- ☐ All **chemicals substances** (both hazardous and non-hazardous) are clearly marked.
- ☐ Standard distance and **aisle-way** is maintained between each machine so that no obstruction is faced on the working floor.
- ☐ **Needle and sharp objects policy** is maintained
- ☐ **Metal detection policy** is maintained
- ☐ Workers are given regular trainings regarding **health and safety**, machines handling and sharp objects handling
- ☐ In-house **doctor and nurse** available.
- ☐ In-house **drinking water facility**. Regularly tested by appropriate authority.
- ☐ **Air emission, noise and light** is measured by appropriate authority and controlled **Accordingly** to ensure good working environment.
- ☐ Separate male/ female **toilet** and sufficient no of cubicle in each is maintained.

- ☐ All used toxic water is delivered to **ETP** through separate drain and biologically treated to suit the environment before emission. Certification and periodical tests are done by Environment Directorate Govt. of Bangladesh
- ™ Available child care room, dry food canteen, dining room, separate training room and separate smoking area.
- ™ BSCI and Sedex (international certification) and factory license issues by Govt. of Bangladesh (local certification) maintained for past few years.

BUILDING SAFETY MEASURES:

- ☐ **There is no high rise factory building** within the factory premise.
- ☐ 4 separate **pre-fabricated steel structured sheds** housing different departments (knitting, garments, utility) covering 11,000sqm floor space within a total area of 40,000sqm (15 acre) land area.
- ☐ Each shed is used for a different function.
- ☐ Appropriately designed, imported and install pre-fabricated steel building structure from Kirby, UAE.
- ☐ Appropriately **foundation designed by certified engineers** for all buildings by Creators Designs Syndicate, a Bangladeshi engineering consulting firm.
- ☐ All buildings are well-maintained with **proper ventilation** and sufficient number of **exits**.
- ☐ Obtained **approval certificates for being used as garments** manufacturing factory from various required authorities.
- ☐ Factory building approval got from the engineering division of Sreepur City Corporation.
- ☐ Factory Inspector of Bangladesh approved the building layout including machine layout.

FIRE SAFETY MEASURES:

- ☐ Updated **fire license** obtained covering whole factory premise from **Bangladesh Fire** Service **Department**.
- ☐ Required checklist as advised by Bangladesh Fire Service and Civil Defense Department are regularly maintained.
- ☐ Sufficient number of emergency exits, fire extinguisher, hose pipe, sand bucket, he t detector, fire alarms, emergency light and other **fire safety measures and equipments** are av l ble on each factory floor according to its requirement.
- ☐ **Staircase** is required on garments floor. Two staircases, each 3m wide and of appropriate **slope** are maintained. Both staircases are on each end of the building and housed in an adjoining separate structure with the production floor.
- ☐ Sufficient number of windows and industrial fan on oppos te ends are fitted on each building so that the total hot air volume inside the factory floor can be emitted outs de within few minutes to ensure overall **ventilation**.
- ☐ All fire safety equipments are regularly checked in ernally to maintain good house-keeping.
- ☐ Sufficient number of full time in-house **Fire-Safe y Officer** is appointed on each production floor.
- ☐ Fire Safety Officers are identified with their special dress. The name list with their photograph is posted on each floor.
- ☐ Monthly **fire drills** (day and night) are conducted according to approved emergency evacuation plan.
- ☐ **Evacuation plan** are posted on each floor both in pictorial and written (local language-Bangla).
- ☐ Regular classroom training to familiarize both workers (old and new) and staff about the emergency evacuation plan.

ELECTRICAL SAFETY MEASURES:

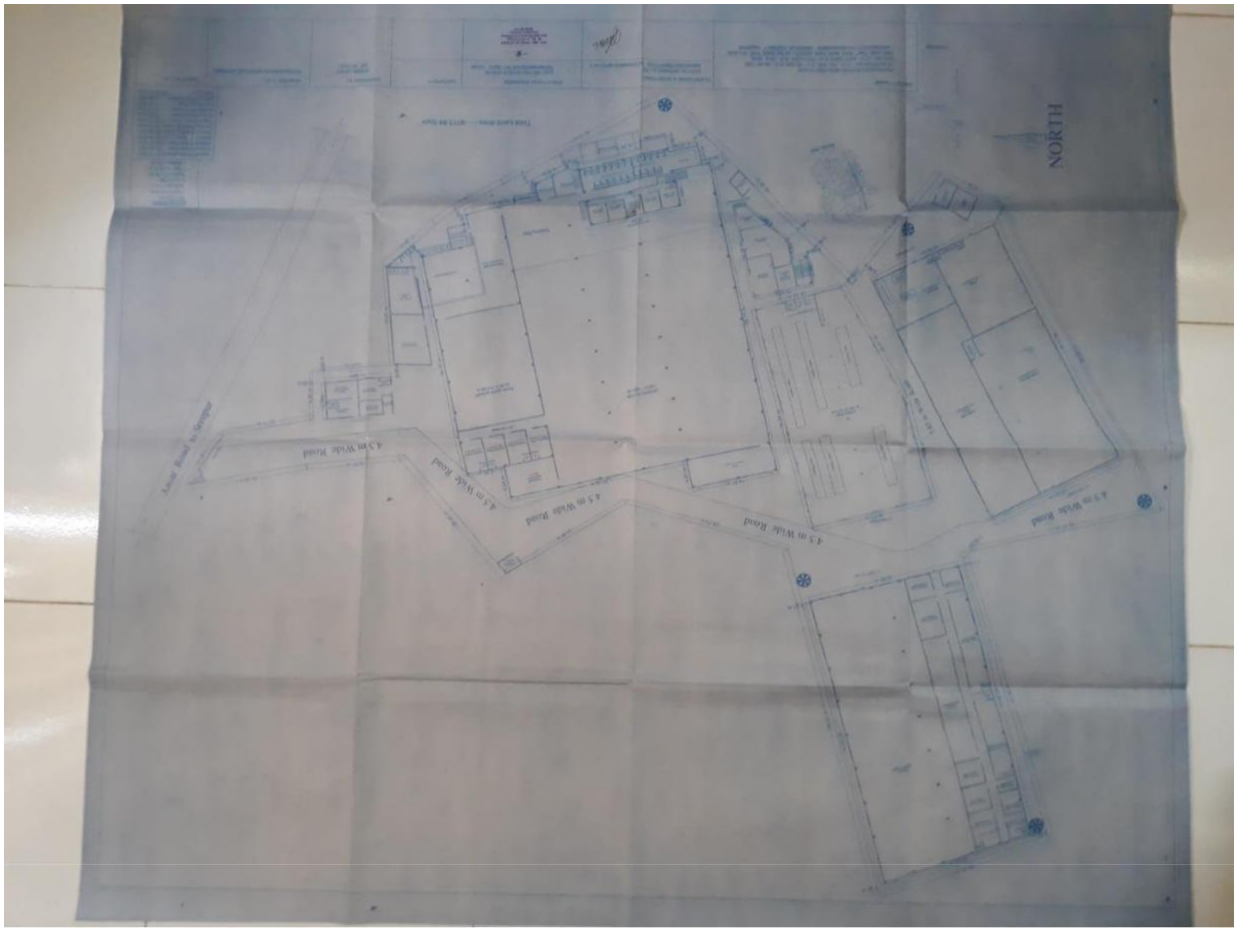
1. The whole factory premi e is within **buss bar trucking system**.
2. All electrical wirings have been constructed as per approved designs by appropriate authorities.
3. All **electrical wires** are covered and properly insulated throughout the factory floor.
4. All electrical appliances (iron, control panel etc) have insulated rubber mats in front, standing on which operators can use the appliances.
5. Rubber insulation and steel sheets have been used to protect wires from various vermin and other unwanted pests.
6. No electrical connections are given in any of the fabric storing and finished garments stores.
7. Certified and trained officer for **Boiler** from Boiler Directorate, Govt. of Bangladesh.
8. Certified and trained engineers are appointed to carry out all **electrical related works**.
9. Certification and license from Energy Regulatory Commission, Govt. of Bangladesh for **Generator** usage.

QUALITY ASSURANCE

1. Dedicated quality assurance team on each production floor
2. **In house laboratory** equipped with equipment's for basic fabric and garments testing.
3. Regular in house **workers' training program** is held to improve quality
4. **Periodical testing** on garments and fabrics produced to check with the requirements.
5. Machines and weighing equipment's are **regularly calibrated** according to fabric requirements.
6. In house **pull testing facilities and equipment's** are available to satisfy requirements from both customer and international standards.

7. In house **metal detection equipment's** are available and maintained to determine conformity of metal free garments before packing into cartons.
8. **Proper records and registry** for incoming and outgoing is maintained in accessories **warehouse** for each order to eliminate errors.

FACTORY MASTER PLAN



GARMENTS RANGE

Boys Items:




www.ralphlaurensite





www.casablancaindia.com


sweet melon
Sweet Melon

LIST OF MACHINERIES

KNITTING SECTION

S/J Circular Knitting M/C , 28/G and 24/G (full feeder lycra attachment)

30” dia 18 nos	Brand:	LISKY TAIWAN
20” dia 1 nos	Brand:	LISKY TAIWAN
22” dia 2 nos	Brand:	LISKY TAIWAN
26” dia 1 nos	Brand:	LISKY TAIWAN

Interlock Circular Knitting M/C ,24/G

30” dia 2 nos	Brand:	LISKY TAIWAN

Rib Circular Knitting M/C, 18/G

30” dia 6 nos	Brand:	LISKY TAIWAN

GARMENTS SECTION

Sample Section :

20	originated brands Single Needle	Sewing M/C Feed of arm	Capacity: Button hole	Cylinder bed PMD Machine	Bartack Fussing	
	Overlock	Elastic Joint	Button Stitch			

Cutting Section:

CAD System (3 Set)	Brand:	Flat lock Pickoting	Winda, China kansai	Snap Button Fixer	Heat Press
CAM (automatic cutting m/c 1 set)	Brand:	2,080 pcs per month (both basic and fashion items)	Winda, China		
Automatic Spreader (2 set)	Brand:		Mac, Japan		

Sewing Section:

18 sewing lines x 24 m/c per line= 3450 m/c Brand: Japanese

Company at a Glance

Company Name :	Ratool Apparels Limited
Type of Business :	Manufacturer and Exporter
Legal Status :	Private Limited Company
Year of Establishment :	2011
Contact Person :	Md. Mosharraf Hossain Chairman
Contact Number :	+880 1713046497
Head Office :	DOHS Baridhara.
Factory :	Anser Road Vagnahati, Sreepur, Gazipur.
Email :	hossain@ratoolapparels.com
Web :	www.ratoolapparels.com
Bank :	ISLAMI BANK BANLADESH LIMITED
SWIFT Code :	IBBLBDDH207
Bank : SWIFT Code:	MERCANTILE BANK LIMITED MBLBBDDH017
Production Capacity Garments:	**30000 pcs per day**
Knitting:	**2.5 tons per day**
Embroidery :	**6500 pcs per day**
Print :	**15000 pcs per day**
Factory Own Space :	**20 Acres**
Turnover:	**$10 million**
Total Manpower :	**1800 person**

LIST OF CERTIFICATION

LIST OF CLIENT

ALDI

Walmart
Save money. Live better.

Kappa

TAILOR VINTAGE
CONNECTICUT ORIGINALS

SERGENT MAJOR
Des histoires plein la tête

DPAM

kandykiss

JCorp Inc.

BODY GLOVE

Comfy Co.

NORMA®

LA HALLE
c'est vraiment vous

DECIMAS

KIDILIZ
GROUP
KIDSWEAR FASHION

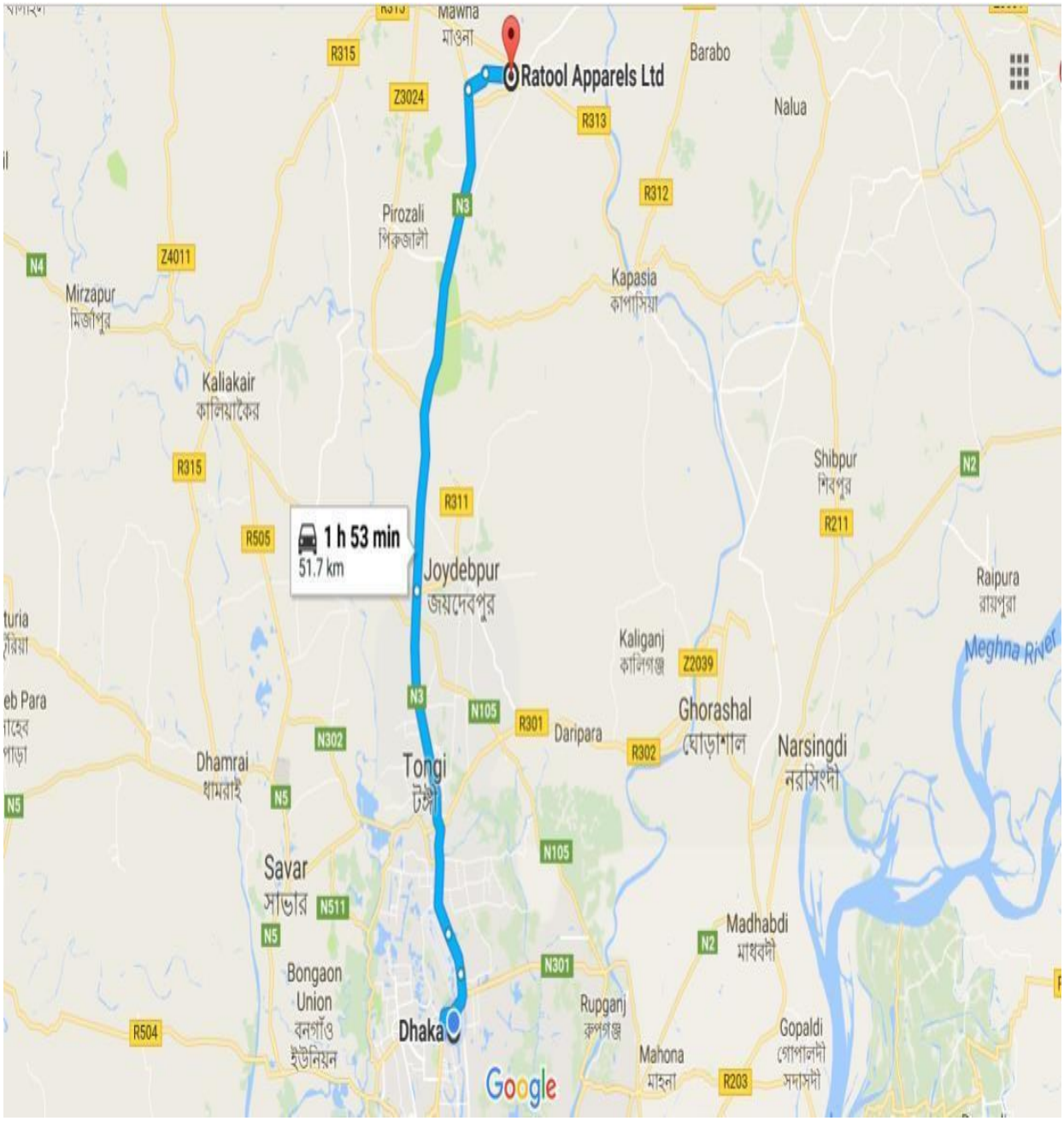
CONTACT DETAILS

Contact Person Name: Md. Mosharrof Hossain
Designation: Chairman
Contact Info : +880 1713046497
Email: hossain@ratoolapparels.com

HEAD OFFICE
Address: House# 288,
Road# 4,
Baridhara
DOHS, Dhaka
Dhaka – 1230
Bangladesh

FACTORY
Address: Ansar Road,
Vangnahati
Sripur,
Gazipur
Bangladesh

FACTORY LOCATION MAP



CHAPTER-03

INDUSTRIAL ATTACHMENT

GARMENTS MANUFACTURING PROCESS FROM KNITTING TO FINISHED PRODUCT

Knitting

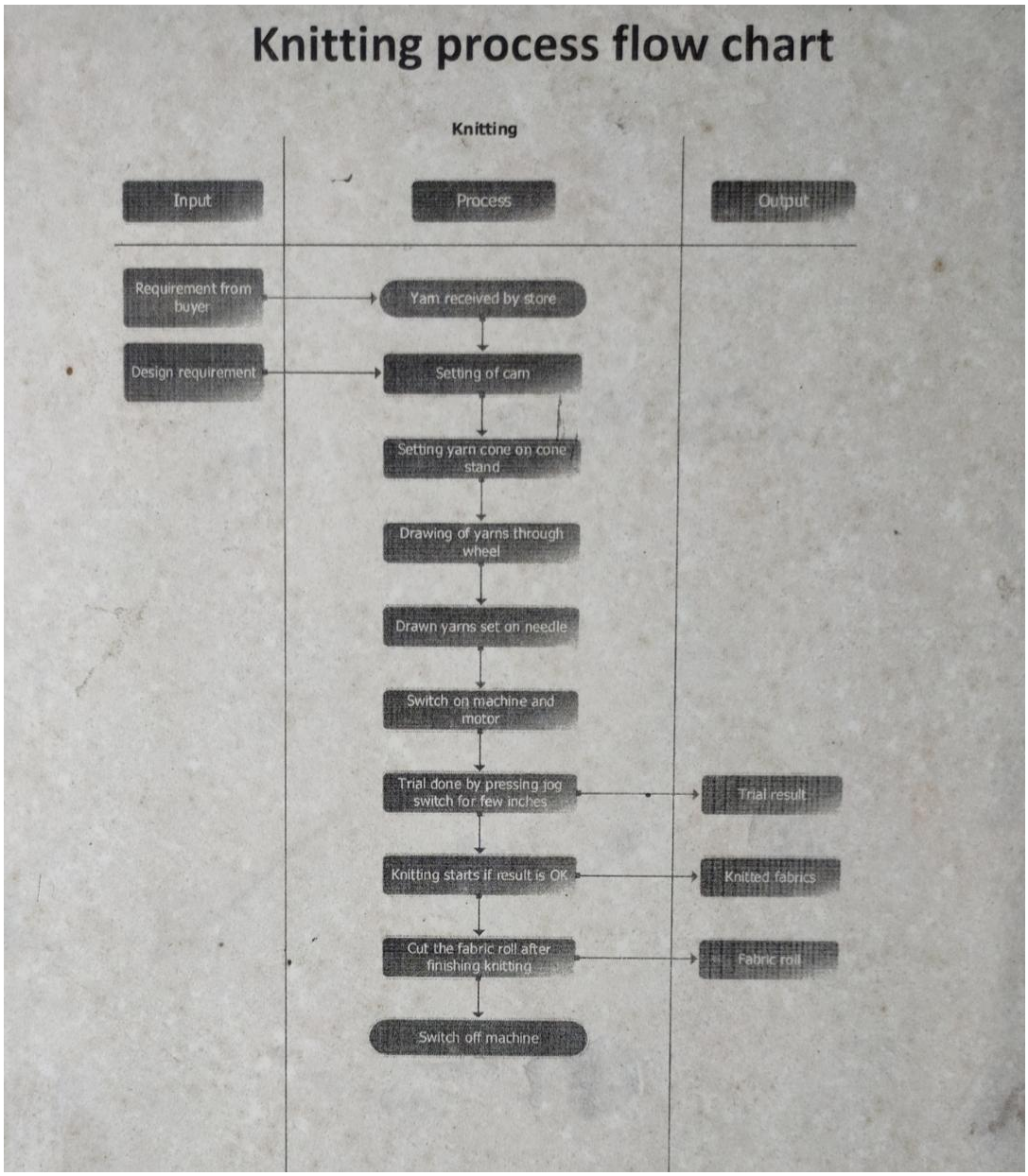
Knitting is a method by which yarn is manipulated to create a textile, or fabric. It is used to create many types of garment. Knitting may be done by hand or by machine.

Woman knitting

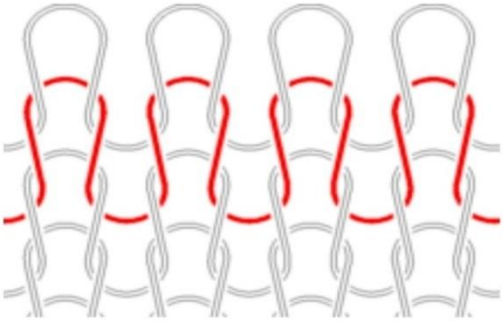
Knitting creates stitches: loops of yarn in a row, either flat or in the round (tubular). There are usually many active stitches on the knitting needle at one time. Knitted fabric consists of a number of consecutive rows of connected loops that intermesh with the next and previous rows. As each row is formed, each newly created loop is pulled through one or more loops from the prior row and placed on the gaining needle so that the loops from the prior row can be pulled off the other needle without unraveling.

Differences in yarn (varying in fibre type, weight, uniformity and twist), needle size, and stitch type allow for a variety of knitted fabrics with different properties, including color, texture, thickness, heat retention, water resistance, and integrity. A small sample of knitwork is known as a swatch.

- **Structure of knitting**



- **Courses and wales**



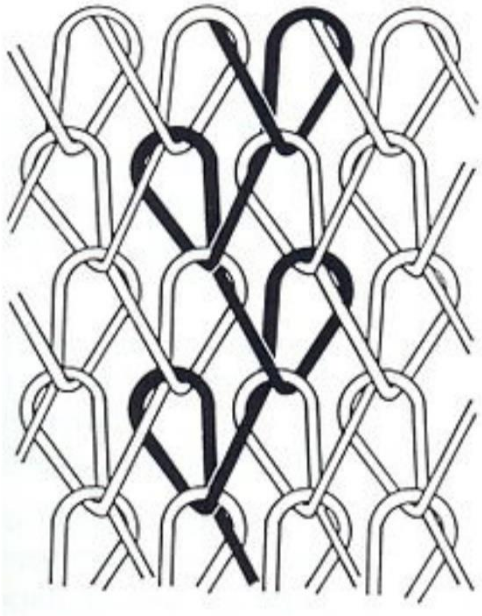
Structure of stockinette stitch, a common weave in knitted fabric. The meandering red path defines one *course*, the path of the yarn through the fabric. The uppermost white loops are unsecured and "active", but they secure the red loops suspended from them. In turn, the red loops secure the white loops just below them, which in turn secure the loops below them, and so on.

Alternating wales of red and yellow knit stitches. Each stitch in a wale is suspended from the one above it.

Like weaving, knitting is a technique for producing a two-dimensional fabric made from a one-dimensional yarn or thread. In weaving, threads are always straight, running parallel either lengthwise (warp threads) or crosswise (weft threads). By contrast, the yarn in knitted fabrics follows a meandering path (a course), forming symmetric loops (also called bights) symmetrically above and below the mean path of the yarn. These meandering loops can be easily stretched in different directions giving knit fabrics much more elasticity than woven fabrics. Depending on the yarn and knitting pattern, knitted garments can stretch as much as 500%. For this reason, knitting was initially developed for garments that must be elastic or stretch in response to the wearer's motions, such as socks and hosiery. For comparison, woven garments stretch mainly along one or other of a related pair of directions that lie roughly diagonally between the warp and the weft, while contracting in the other

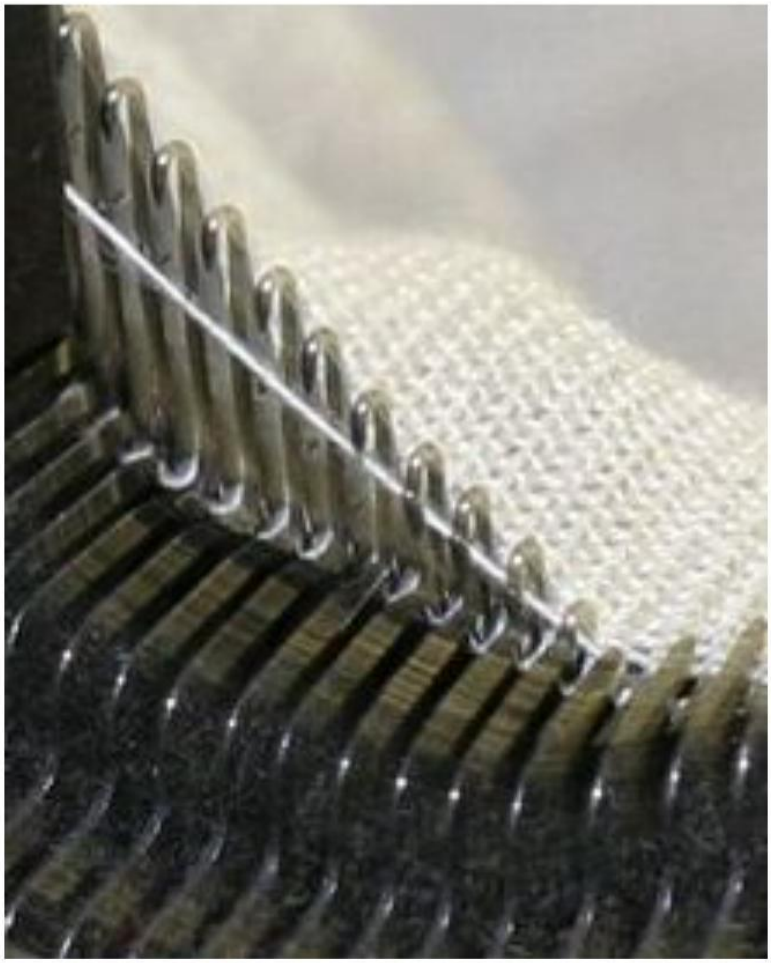
direction of the pair (stretching and contracting with the bias), and are not very elastic, unless they are woven from stretchable material such as spandex. Knitted garments are often more form-fitting than woven garments, since their elasticity allows them to contour to the body's outline more closely; by contrast, curvature is introduced into most woven garments only with sewn darts, flares, gussets and gores, the seams of which lower the elasticity of the woven fabric still further. Extra curvature can be introduced into knitted garments without seams, as in the heel of a sock; the effect of darts, flares, etc. can be obtained with short rows or by increasing or decreasing the number of stitches. Thread used in weaving is usually much finer than the yarn used in knitting, which can give the knitted fabric more bulk and less drape than a woven fabric.

If they are not secured, the loops of a knitted course will come undone when their yarn is pulled; this is known as ripping out, unravelling knitting, or humorously, frogging (because you 'rip it', this sounds like a frog croaking: 'rib-bit'). To secure a stitch, at least one new loop is passed through it. Although the new stitch is itself unsecured ("active" or "live"), it secures the stitch(es) suspended from it. A sequence of stitches in which each stitch is suspended from the next is called a wale. To secure the initial stitches of a knitted fabric, a method for casting on is used; to secure the final stitches in a wale, one uses a method of binding/casting off. During knitting, the active stitches are secured mechanically, either from individual hooks (in knitting machines) or from a knitting needle or frame in hand-knitting.



Basic pattern of warp knitting. Parallel yarns zigzag lengthwise along the fabric, each loop securing a loop of an adjacent strand from the previous row.

- **Weft and warp knitting**
  There are two major varieties of knitting: weft knitting and warp knitting. In the more common weft knitting, the wales are perpendicular to the course of the yarn. In warp knitting, the wales and courses run roughly parallel. In weft knitting, the entire fabric may be produced from a single yarn, by adding stitches to each wale in turn, moving across the fabric as in a raster scan. By contrast, in warp knitting, one yarn is required for every wale. Since a typical piece of knitted fabric may have hundreds of wales, warp knitting is typically done by machine, whereas weft knitting is done by both hand and machine. Warp-knitted fabrics such as tricot and milanese are resistant to runs, and are commonly used in lingerie.

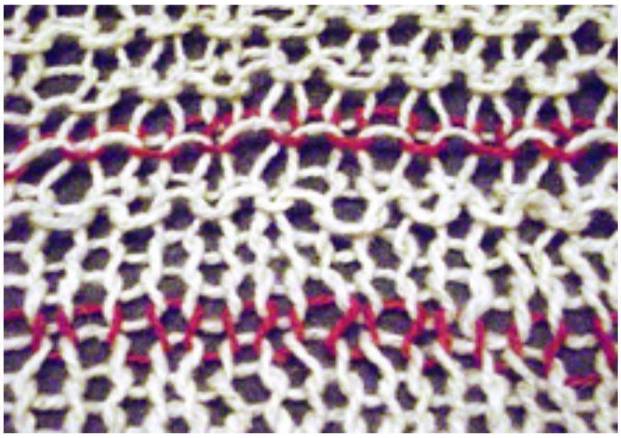


A modern knitting machine in the process of weft knitting

Weft-knit fabrics may also be knit with multiple yarns, usually to produce interesting color patterns. The two most common approaches are intarsia and stranded colorwork. In intarsia, the yarns are used in well-segregated regions, e.g., a red apple on a field of green; in that case, the yarns are kept on separate spools and only one is knitted at any time. In the more complex stranded approach, two or more yarns alternate repeatedly within

one row and all the yarns must be carried along the row, as seen in Fair Isle sweaters. Double knitting can produce two separate knitted fabrics simultaneously (e.g., two socks). However, the two fabrics are usually integrated into one, giving it great warmth and excellent drape.

- **Knit and purl stitches**



Two courses of red yarn illustrating two basic fabric types. The lower red course is knit into the white row below it and is itself knit on the next row; this produces 'stockinette' stitch. The upper red course is purled into the row below and then is knit, consistent with 'garter' stitch.

A dropped stitch, or missed stitch, is a common error that creates an extra loop to be fixed.

In securing the previous stitch in a wale, the next stitch can pass through the previous loop from either below or above. If the former, the stitch is denoted as a 'knit stitch' or a 'plain stitch;' if the latter, as a 'purl stitch'. The two stitches are related in that a knit stitch seen from one side of the fabric appears as a purl stitch on the other side.

The two types of stitches have a different visual effect; the knit stitches look like 'V's stacked vertically, whereas the purl stitches look like a wavy horizontal line across the fabric. Patterns and pictures can be created in knitted fabrics by using knit and purl stitches as "pixels"; however, such pixels are usually rectangular, rather than square, depending on the gauge/tension of the knitting. Individual stitches, or rows of stitches, may be made taller by drawing more yarn into the new loop (an elongated stitch), which is the basis for uneven knitting: a row of tall stitches may alternate with one or more rows of short stitches for an interesting visual effect. Short and tall stitches may also alternate within a row, forming a fish-like oval pattern.
In the simplest of hand-knitted fabrics, every row of stitches are all knit (or all purl); this creates a garter stitch fabric. Alternating rows of all knit stitches and all purl stitches creates a stockinette pattern/stocking stitch. Vertical stripes (ribbing) are possible by having alternating wales of knit and purl stitches. For example, a common choice is 2x2 ribbing, in which two wales of knit stitches are followed by two wales of purl stitches, etc. Horizontal striping (welting) is also possible, by alternating rows of knit and purl stitches. Checkerboard patterns (basketweave) are also possible, the smallest of which is known as seed/moss stitch: the stitches alternate between knit and purl in every wale and along every row.
Fabrics in which each knitted row is followed by a purled row, such as in stockinette/stocking stitch, have a tendency to curl—top and bottom curl toward the front (or knitted side) while the sides curl toward the back (or purled side); by contrast, those in which knit and purl stitches are arranged symmetrically (such as ribbing, garter stitch or seed/moss stitch) have more texture and tend to lie flat.
Wales of purl stitches have a tendency to recede, whereas those of knit stitches tend to come forward, giving the fabric more stretchability. Thus, the purl wales in ribbing tend to be invisible, since the neighboring knit wales come forward. Conversely, rows of purl stitches tend to form an embossed ridge relative to a row of knit stitches. This is the basis of shadow knitting, in which the appearance of a knitted fabric changes when viewed from different directions.
Typically, a new stitch is passed through a single unsecured ('active') loop, thus lengthening that wale by one stitch. However, this need not be so; the new loop may be passed through an already secured stitch lower down on the fabric, or even betweensecured stitches (a dip stitch). Depending on the distance between where the loop is drawn through the fabric and where it is knitted, dip stitches can produce a subtle stippling or long lines across the surface of the fabric, e.g., the lower leaves of a flower. The new loop may also be passed between two stitches in the 'present' row, thus clustering the intervening stitches; this approach is often used to produce a smocking effect in the fabric. The new loop may also be passed through 'two or more' previous stitches, producing a decrease and merging wales together. The

merged stitches need not be from the same row; for example, a tuck can be formed by knitting stitches together from two different rows, producing a raised horizontal welt on the fabric.

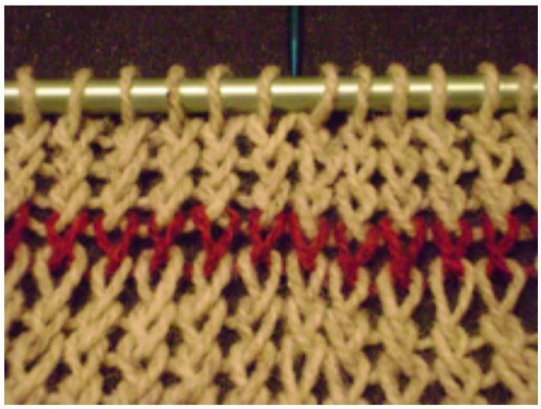
Not every stitch in a row need be knitted; some may be 'missed' (unknitted and passed to the active needle) and knitted on a subsequent row. This is known as slip-stitch knitting. The slipped stitches are naturally longer than the knitted ones. For example, a stitch slipped for one row before knitting would be roughly twice as tall as its knitted counterparts. This can produce interesting visual effects, although the resulting fabric is more rigid because the slipped stitch 'pulls' on its neighbours and is less deformable. Mosaic knitting is a form of slip-stitch knitting that knits alternate colored rows and uses slip stitches to form patterns; mosaic-knit fabrics tend to be stiffer than patterned fabrics produced by other methods such as Fair-Isle knitting.

In some cases, a stitch may be deliberately left unsecured by a new stitch and its wale allowed to disassemble. This is known as drop-stitch knitting, and produces a vertical ladder of see-through holes in the fabric, corresponding to where the wale had been.

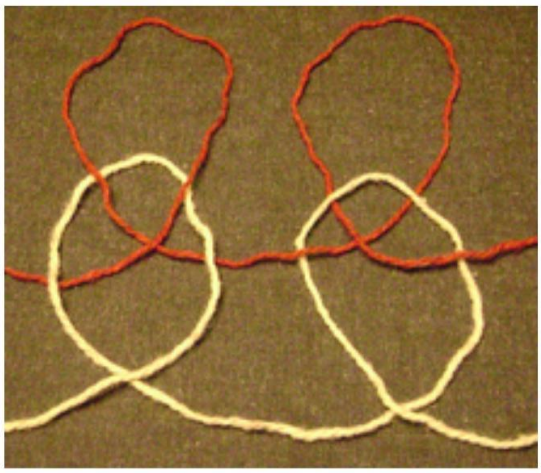
- **Differences between knitting and crocheting**

For many beginners, telling the difference between knitting and crocheting is very tricky. Both have the same methods of stitching yarn together, but their methods are fairly different. When knitting, the stitches form a shape that is similar to a "V", while in crochet the stitches are knotted together. Each textile has its own specialties and methods. When knitting, a pair of long needles is needed to be able to form the loops from one set of loop to another through the needles. When crocheting, only one single hook is used to be able to hook the loops together directly onto the clothes. Often times, crocheting is easier to work with at first as compared to knitting.

- **Right- and left-plaited stitches**



The stitches on the right are right-plaited, whereas the stitches on the left are left-plaited.



Within limits, an arbitrary number of twists may be added to new stitches, whether they be knit or purl. Here, a single twist is illustrated, with left-plaited and right-plaited stitches on the left and right, respectively.

Both knit and purl stitches may be twisted: usually once if at all, but sometimes twice and (very rarely) thrice. When seen from above, the twist can be clockwise (right yarn over left) or counterclockwise (left yarn over right); these are denoted as right- and left-plaited stitches, respectively. Hand-knitters generally produce right-plaited stitches by knitting or purling through the back loops, i.e., passing the needle through the initial stitch in an unusual way, but wrapping the yarn as usual. By contrast, the left-plaited stitch is generally formed by hand-knitters by wrapping the yarn in the opposite way, rather than by any change in the needle. Although they are mirror images in form, right- and left-plaited stitches are functionally equivalent. Both types of plaited stitches give a subtle but interesting visual texture, and tend to draw the fabric inwards, making it stiffer. Plaited stitches are a common method for knitting jewelry from fine metal wire.

Illustration of entrelac. The blue and white wales are parallel to each other, but both are perpendicular to the black and gold wales, resembling basket weaving.

- **Edges and joins between fabrics**

The initial and final edges of a knitted fabric are known as the cast-on and bound/cast-off edges. The side edges are known as the selvages; the word derives from "self-edges", meaning that the stitches do not need to be secured by anything else. Many types of selvages have been developed, with different elastic and ornamental properties.

Vertical and horizontal edges can be introduced within a knitted fabric, e.g., for button holes, by binding/casting off and re-casting on again (horizontal) or by knitting the fabrics on either side of a vertical edge separately.

Two knitted fabrics can be joined by embroidery-based grafting methods, most commonly the Kitchener stitch. New wales can be begun from any of the edges of a knitted fabric; this is known as picking up stitches and is the basis for entrelac, in which the wales run perpendicular to one another in a checkerboard pattern.

- **Cables, increases, and lace**

Ordinarily, stitches are knitted in the same order in every row, and the wales of the fabric run parallel and vertically along the fabric. However, this need not be so, since the order in which stitches are knitted may be permuted so that wales cross over one

Illustration of cable knitting. The central braid is formed from 2x2 ribbing in which the background is formed of purl stitches and the cables are each two wales of knit stitches. By changing the order in which the stitches are knit, the wales can be made to cross.

another, forming a cable pattern. Cables patterns tend to draw the fabric together, making it denser and less elastic; Aran sweaters are a common form of knitted cabling. Arbitrarily complex braid patterns can be done in cable knitting, with the proviso that the wales must move ever upwards; it is generally impossible for a wale to move up and then down the fabric. Knitters have developed methods for giving the illusion of a circular wale, such as appear in Celtic knots, but these are inexact approximations. However, such circular wales are possible using Swiss darning, a form of embroidery, or by knitting a tube separately and attaching it to the knitted fabric.

In lace knitting, the pattern is formed by making small, stable holes in the fabric, generally with yarn overs.

A wale can split into two or more wales using increases, most commonly involving a yarn over. Depending on how the increase is done, there is often a hole in the fabric at the point of the increase. This is used to great effect in lace knitting, which consists of making patterns and pictures using such holes, rather than with the stitches themselves. The large and many holes in lacy knitting makes it extremely elastic; for example, some Shetland "wedding-ring" shawls are so fine that they may be drawn through a wedding ring.
By combining increases and decreases, it is possible to make the direction of a wale slant away from vertical, even in weft knitting. This is the basis for bias knitting, and can be used for visual effect, similar to the direction of a brush-stroke in oil painting.

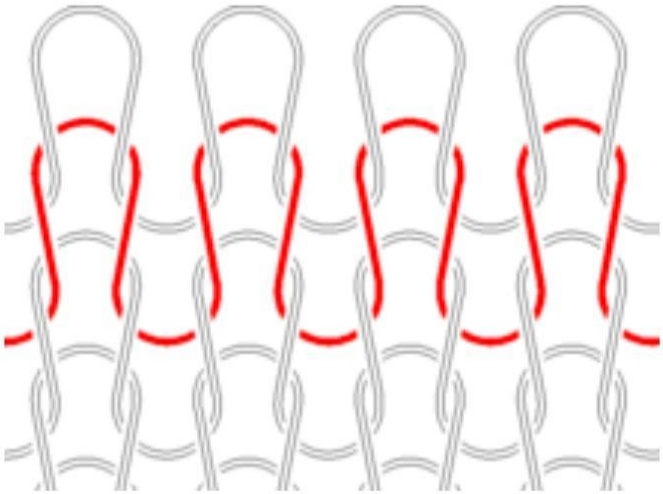
- **Ornamentations and additions**

Various point-like ornaments may be added to knitting for their look or to improve the wear of the fabric. Examples include various types of bobbles, sequins and beads. Long loops can also be drawn out and secured, forming a "shaggy" texture to the fabric; this is known as loop knitting. Additional patterns can be made on the surface of the knitted fabric using embroidery; if the embroidery resembles knitting, it is often called Swiss darning. Various closures for the garments, such as frogs and buttons can be added; usually buttonholes are knitted into the garment, rather than cut.

Ornamental pieces may also be knitted separately and then attached using applique. For example, differently colored leaves and petals of a flower could be knit separately and attached to form the final picture. Separately knitted tubes can be applied to a knitted fabric to form complex Celtic knots and other patterns that would be difficult to knit.
Unknitted yarns may be worked into knitted fabrics for warmth, as is done in tufting and "weaving" (also known as "couching").

- **History and culture of knitting**

The word is derived from knot and ultimately from the Old English cnyttan, to knot.
The exact origins of knitting are unknown, the earliest known examples being cotton socks found in Egyptian pyramids. Nålebinding (Danish: literally "binding with a needle" or "needle-binding") is a fabric creation technique predating both knitting and crochet.
The first commercial knitting guilds appear in Western Europe in the early fifteenth century (Tournai in 1429, Barcelona in 1496). The Guild of Saint Fiacre was founded in Paris in 1527 but the archives mention an organization (not necessarily a guild) of knitters from 1268. The occupation: "cap knitter" describes Margaret Yeo, of London, in 1473.
With the invention in 1589 of the stocking frame, an early form of knitting machine, knitting "by hand" became a craft used by country people with easy access to fiber. Similar to quilting, spinning, and needlepoint, hand knitting became a leisure activity for the wealthy. English Roman Catholic priest and a former Anglican bishop, Richard Rutt, authored a history of the craft in A History of Hand Knitting (Batsford, 1987). His collection of books about knitting is now housed at the Winchester School of Art (University of Southampton).



Schematic of stockinette stitch, the most basic weft-knit fabric

- **Properties of fabrics**

The topology of a knitted fabric is relatively complex. Unlike woven fabrics, where strands usually run straight horizontally and vertically, yarn that has been knitted follows a looped path along its row, as with the red strand in the diagram at left, in which the loops of one row have all been pulled through the loops of the row below it.

Because there is no single straight line of yarn anywhere in the pattern, a knitted piece of fabric can stretch in all directions. This elasticity is all but unavailable in woven fabrics which only stretch along the bias. Many modern stretchy garments, even as they rely on elastic synthetic materials for some stretch, also achieve at least some of their stretch through knitted patterns.

Close-up of front of stockinette stitch

Close-up of back of stockinette stitch, also same appearance as reverse stockinette stitch

The basic knitted fabric (as in the diagram, and usually called a stocking or stockinette pattern) has a definite "right side" and "wrong side". On the right side, the visible portions of the loops are the verticals connecting two rows which are arranged in a grid of V shapes. On the wrong side, the ends of the loops are visible, both the tops and bottoms, creating a much more bumpy texture sometimes called reverse stockinette. (Despite being the "wrong side," reverse stockinette is frequently used as a pattern in its own right.) Because the yarn holding rows together is all on the front, and the yarn holding side-by-side stitches together is all on the back, stockinette fabric has a strong tendency to curl toward the front on

the top and bottom, and toward the back on the left and right side.
Stitches can be worked from either side, and various patterns are created by mixing regular knit stitches with the "wrong side" stitches, known as purl stitches, either in columns (ribbing), rows (garter, welting), or more complex patterns. Each fabric has different properties: a garter stitch has much more vertical stretch, while ribbing stretches much more horizontally. Because of their front-back symmetry, these two fabrics have little curl, making them popular as edging, even when their stretch properties are not desired.

Different combinations of knit and purl stitches, along with more advanced techniques, generate fabrics of considerably variable consistency, from gauzy to very

Close-up of knitting

dense, from highly stretchy to relatively stiff, from flat to tightly curled, and so on.

- **Texture**

The most common texture for a knitted garment is that generated by the flat stockinette stitch—as seen, though very small, in machine-made stockings and T-shirts—which is worked in the round as nothing but knit stitches, and worked flat as alternating rows of knit and purl. Other simple textures can be made with nothing but knit and purl stitches, including garter stitch, ribbing, and moss and seed stitches. Adding a "slip stitch" (where a loop is passed from one needle to the other) allows for a wide range of textures, including heel and linen stitches as well as a number of more complicated patterns.

Some more advanced knitting techniques create a surprising variety of complex textures. Combining certain increases, which can create small eyelet holes in the resulting fabric, with assorted decreases is key to creating knitted lace, a very open fabric resembling needle or bobbin lace. Open vertical stripes can be created using the drop-stitch knitting technique. Changing the order of stitches from one row to the next, usually with the help of a cable needle or stitch holder, is key to cable knitting, producing an endless variety of cables, honeycombs, ropes, and Aran

Close-up of ribbing

sweater patterning. Entrelac forms a rich checkerboard texture by knitting small squares, picking up their side edges, and knitting more squares to continue the piece.

Fair Isle knitting uses two or more colored yarns to create patterns and forms a thicker and less flexible fabric.

The appearance of a garment is also affected by the weight of the yarn, which describes the thickness of the spun fibre. The thicker the yarn, the more visible and apparent stitches will be; the thinner the yarn, the finer the texture.

- **Color**

Plenty of finished knitting projects never use more than a single color of yarn, but there are many ways to work in multiple colors. Some yarns are dyed to be either variegated (changing color every few stitches in a random fashion) or self-striping (changing every few rows). More complicated techniques permit large fields of color (intarsia, for example), busy small-scale patterns of color (such as Fair Isle), or both (double knitting and slip-stitch color, for example).

Yarn with multiple shades of the same hue are called ombre, while a yarn with multiple hues may be known as a given colorway; a green, red and yellow yarn might

be dubbed the "Parrot Colorway" by its manufacturer, for example. Heathered yarns contain small amounts of fibre of different colours, while tweed yarns may have greater amounts of different colored fibres.

- **Hand knitting process**

There are many hundreds of different knitting stitches used by hand knitters. A piece of hand knitting begins with the process of casting on, which involves the initial creation of the stitches on the needle. Different methods of casting on are used for different effects: one may be stretchy enough for lace, while another provides a decorative edging. Provisional cast-ons are used when the knitting will continue in both directions from the cast-on. There are various methods employed to cast on, such as the "thumb method" (also known as "slingshot" or "long-tail" cast-ons), where the stitches are created by a series of loops that will, when knitted, give a very loose edge ideal for "picking up stitches" and knitting a border; the "double needle method" (also known as "knit-on" or "cable cast-on"), whereby each loop placed on the needle is then "knitted on," which produces a firmer edge ideal on its own as a border; and many more. The number of active stitches remains the same as when cast on unless stitches are added (an increase) or removed (a decrease).
Most Western-style hand knitters follow either the English style (in which the yarn is held in the right hand) or the Continental style (in which the yarn is held in the left hand).
There are also different ways to insert the needle into the stitch. Knitting through the front of a stitch is called Western knitting. Going through the back of a stitch is called Eastern knitting. A third method, called combination knitting, goes through the front of a knit stitch and the back of a purl stitch.
Once the hand knitted piece is finished, the remaining live stitches are "cast off". Casting (or "binding") off loops the stitches across each other so they can be removed from the needle without unravelling the item. Although the mechanics are different from casting on, there is a similar variety of methods.
In hand knitting certain articles of clothing, especially larger ones like sweaters, the final knitted garment will be made of several knitted pieces, with individual sections of the garment hand knitted separately and then sewn together. Seamless knitting, where a whole garment is hand knit as a single piece, is also possible. Elizabeth Zimmermann is probably the best-known proponent of seamless or circular hand knitting techniques. Smaller items, such as socks and hats, are usually knit in one piece on double-pointed needles or circular needles. Hats in particular can be started "top down" on double pointed needles with the increases added until the preferred size is achieved, switching to an appropriate circular needle when enough stitches have been added. Care must be taken to bind off at a tension that will allow the "give" needed to comfortably fit on the head. (See Circular knitting.)

- **Materials of Knitting**

- **Yarn**

Yarn for hand-knitting is usually sold as balls or skeins (hanks), and it may also be wound on spools or cones. Skeins and balls are generally sold with a yarn-band, a

label that describes the yarn's weight, length, dye lot, fiber content, washing instructions, suggested needle size, likely gauge/tension, etc. It is common practice to save the yarn band for future reference, especially if additional skeins must be purchased. Knitters generally ensure that the yarn for a project comes from a single dye lot. The dye lot specifies a group of skeins that were dyed together and thus have precisely the same color; skeins from different dye-lots, even if very similar in color, are usually slightly different and may produce a visible horizontal stripe when knitted together. If a knitter buys insufficient yarn of a single dye lot to complete a project, additional skeins of the same dye lot can sometimes be obtained from other yarn stores or online. Otherwise, knitters can alternate skeins every few rows to help the dye lots blend together easier.

A hank of wool yarn (center) is uncoiled into its basic loop. A tie is visible at the left; after untying, the hank may be wound into a ball or balls suitable for knitting. Knitting from a normal hank directly is likely to tangle the yarn, producing snarls.

The thickness or weight of the yarn is a significant factor in determining the gauge/tension, i.e., how many stitches and rows are required to cover a given area for a given stitch pattern. Thicker yarns generally require thicker knitting needles, whereas thinner yarns may be knit with thick or thin needles. Hence, thicker yarns generally require fewer stitches, and therefore less time, to knit up a given garment. Patterns and motifs are coarser with thicker yarns; thicker yarns produce bold visual effects, whereas thinner yarns are best for refined patterns. Yarns are grouped by

thickness into six categories: superfine, fine, light, medium, bulky and superbulky; quantitatively, thickness is measured by the number of wraps per inch (WPI). In the British Commonwealth (outside North America) yarns are measured as 1ply, 2ply, 3ply, 4ply, 5ply, 8ply (or double knit),10ply and 12ply (triple knit). The related weight per unit length is usually measured in tex or denier.

Before knitting, the knitter will typically transform a hank/skein into a ball where the yarn emerges from the center of the ball; this making the knitting easier by preventing the yarn from becoming easily tangled. This transformation may be done by hand, or with a device known as a ballwinder. When knitting, some knitters enclose their balls in jars to keep them clean and untangled with other yarns; the free yarn passes through a small hole in the jar-lid.

A yarn's usefulness for a knitting project is judged by several factors, such as its loft (its ability to trap air), its resilience (elasticity under tension), its washability and colorfastness, its hand (its feel, particularly softness vs.

Transformation of a hank of lavender silk yarn (top) into a ball in which the knitting yarn emerges from the center (bottom). The latter is better for knitting, since the yarn is much less likely to tangle.

scratchiness), its durability against abrasion, its resistance to pilling, its hairiness (fuzziness), its tendency to twist or untwist, its overall weight and drape, its blocking and felting qualities, its comfort (breathability, moisture absorption, wicking properties) and of course its look, which includes its color, sheen, smoothness and ornamental features. Other factors include allergenicity; speed of drying; resistance to chemicals, moths, and mildew; melting point and flammability; retention of static electricity; and the propensity to become stained and to accept

dyes. Different factors may be more significant than others for different knitting projects, so there is no one "best" yarn. The resilience and propensity to (un)twist are general properties that affect the ease of hand-knitting. More resilient yarns are more forgiving of irregularities in tension; highly twisted yarns are sometimes difficult to knit, whereas untwisting yarns can lead to split stitches, in which not all the yarn is knitted into a stitch. A key factor in knitting is stitch definition, corresponding to how well complicated stitch patterns can be seen when made from a given yarn. Smooth, highly spun yarns are best for showing off stitch patterns; at the other extreme, very fuzzy yarns or eyelash yarns have poor stitch definition, and any complicated stitch pattern would be invisible.

Although knitting may be done with ribbons, metal wire or more exotic filaments, most yarns are made by spinning fibers. In spinning, the fibers are twisted so that the yarn resists breaking under tension; the twisting may be done in either direction, resulting in a S-twist yarn. If the fibers are first aligned by combing them, the yarn is smoother and called a worsted; by contrast, if the fibers are carded but not combed, the yarn is fuzzier and called woolen-spun. The fibers making up a yarn may be continuous filament fibers such as silk and many synthetics, or they may be staples (fibers of an average length, typically a few inches); naturally filament fibers are sometimes cut up into staples before spinning. The strength of the spun yarn against breaking is determined by the amount of twist, the length of the fibers and the thickness of the yarn. In general, yarns become stronger with more twist (also called worst), longer fibers and thicker yarns (more fibers); for example, thinner yarns require more twist than do thicker yarns to resist breaking under tension. The thickness of the yarn may vary along its length; a slub is a much thicker section in which a mass of fibers is incorporated into the yarn.

The spun fibers are generally divided into animal fibers, plant and synthetic fibers. These fiber types are chemically different, corresponding to proteins, carbohydrates and synthetic polymers, respectively. Animal fibers include silk, but generally are long hairs of animals such as sheep (wool), goat (angora, or cashmere goat), rabbit (angora), llama, alpaca, dog, cat, camel, yak, and muskox (qiviut). Plants used for fibers include cotton, flax (for linen), bamboo, ramie, hemp, jute, nettle, raffia, yucca, coconut husk, banana fiber, soy and corn. Rayon and acetate fibers are also produced from cellulose mainly derived from trees. Common synthetic fibers include acrylics,[16] polyesters such as dacron and ingeo, nylon and other polyamides, and olefins such as polypropylene. Of these types, wool is generally favored for knitting, chiefly owing to its superior elasticity, warmth and (sometimes) felting. It is also common to blend different fibers in the yarn, e.g., 85% alpaca and 15% silk. Even within a type of fiber, there can be great variety in the length and thickness of the fibers; for example, Merino wool and Egyptian cotton are favored because they produce exceptionally long, thin (fine) fibers for their type.

A single spun yarn may be knitted as is, or braided or plied with another. In plying, two or more yarns are spun together, almost always in the opposite sense from which they were spun individually; for example, two yarns are usually plied with an S-twist. The opposing twist relieves some of the yarns' tendency to curl up and

produces a thicker, balanced yarn. Plied yarns may themselves be plied together, producing cabled yarns or multi-stranded yarns. Sometimes, the yarns being plied are fed at different rates, so that one yarn loops around the other, as in bouclé. The single yarns may be dyed separately before plying, or afterwards to give the yarn a uniform look.

The dyeing of yarns is a complex art that has a long history. However, yarns need not be dyed. They may be dyed just one color, or a great variety of colors. Dyeing may be done industrially, by hand or even hand-painted onto the yarn. A great variety of synthetic dyes have been developed since the synthesis of indigo dye in the mid-19th century; however, natural dyes are also possible, although they are generally less brilliant. The color-scheme of a yarn is sometimes called its colorway. Variegated yarns can produce interesting visual effects, such as diagonal stripes; conversely, a variegated yarn may obscure a detailed knitting design, such as a cable or lace pattern.

- **Metal wire**

There are multiple commercial applications for knit fabric made of metal wire by knitting machines. Steel wire of various sizes may be used for electric and magnetic shielding due to its conductivity. Stainless steel may be used in a coffee press for its rust resistance.

Metal wire can also be used as jewelry.

- **Glass and wax**

Close-up of "Jitterbug" – knitted glass by Carol Milne

Knitted glass combines knitting, lost-wax casting, mold-making, and kiln-casting. The process involves:

1. knitting with wax strands
2. surrounding the knitted wax piece with a heat-tolerant refractory material
3. removing the wax by melting it out, thus creating a mold

4. placing the mold in a kiln where lead crystal glass melts into the mold
5. after the mold cools, the mold material is removed to reveal the knitted glass piece.

- **Tools of Knitting**

The process of knitting has three basic tasks:

1. the active (unsecured) stitches must be held so they don't drop
2. these stitches must be released sometime after they are secured
3. new bights of yarn must be passed through the fabric, usually through active stitches, thus securing them.

In very simple cases, knitting can be done without tools, using only the fingers to do these tasks; however, knitting is usually carried out using tools such as knitting needles, knitting machines or rigid frames. Depending on their size and shape, the rigid frames are called stocking frames, knitting boards, knitting rings (also called knitting looms) or knitting spools (also known as knitting knobbies, knitting nancies, or corkers). There is also a technique called knooking[19] of knitting with a crochet hook that has a cord attached to the end, to hold the stitches while they're being worked. Other tools are used to prepare yarn for knitting, to measure and design knitted garments, or to make knitting easier or more comfortable.

- **Needles**
- **Knitting needle**

Knitting needles in a variety of sizes and materials. Different materials have varying amounts of friction, and are suitable for different yarn types.

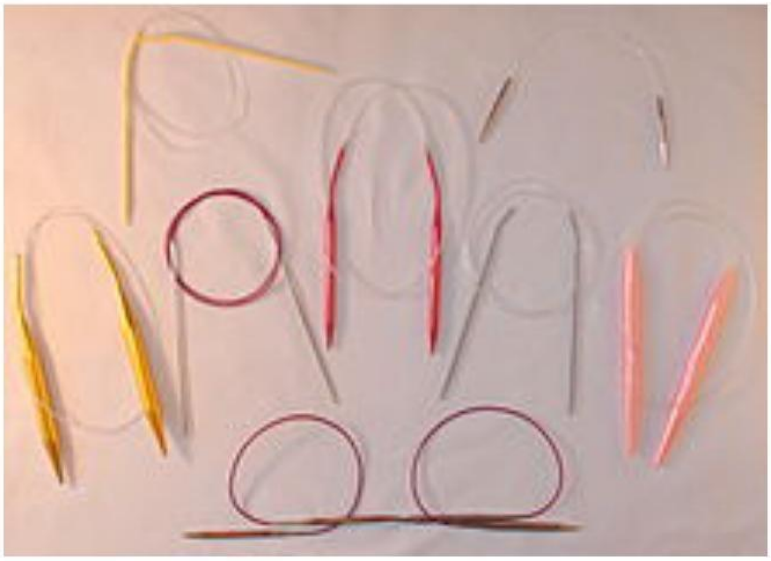
There are three basic types of knitting needles (also called "knitting pins"). The first and most common type consists of two slender, straight sticks tapered to a point at one end, and with a knob at the other end to prevent stitches from slipping off. Such needles are usually 10–16 inches (250–410 mm) long but, due to the compressibility of knitted fabrics, may be used to knit pieces significantly wider. The most important property of needles is their diameter, which ranges from below 2 to 25 mm (roughly 1 inch). The diameter affects the size of stitches, which affects the gauge/tension of the knitting and the elasticity of the fabric. Thus, a simple way to change gauge/tension is to use different needles, which is the basis of uneven knitting. Although the diameter of the knitting needle is often measured in millimeters, there are several measurement systems, particularly those specific to the United States, the United Kingdom and Japan; a conversion table is given at knitting needle. Such knitting needles may be made out of any materials, but the most common materials are metals, wood, bamboo, and plastic. Different materials have different frictions and grip the yarn differently; slick needles such as metallic needles are useful for swift knitting, whereas rougher needles such as bamboo offer more friction and are therefore less prone to

dropping stitches. The knitting of new stitches occurs only at the tapered ends.

Double-pointed knitting needles in various materials and sizes. They come in sets of four, five or six.

Needles with lighted tips have been sold to allow knitters to knit in the dark.
The second type of knitting needles are straight, double-pointed knitting needles (also called "DPNs"). Double-pointed needles are tapered at both ends, which allows them to be knit from either end. DPNs are typically used for circular knitting, especially smaller tube-shaped pieces such as sleeves, collars, and socks; usually one needle is active while the others hold the remaining active stitches. DPNs are somewhat shorter (typically 7 inches) and are usually sold in sets of four or five.

The third needle type consists of circular needles, which are long, flexible double-pointed needles. The two tapered ends (typically 5 inches (130 mm) long) are rigid and straight, allowing for easy knitting; however, the two ends are connected by a flexible strand (usually nylon) that allows the two ends to be brought together. Circular needles are typically 24-60 inches long, and are usually used singly or in pairs; again, the width of the knitted piece may be significantly longer than the length of the circular needle. Interchangeable needles are a subset of circular needles. They are kits consist of pairs of needles with usually nylon cables or cords. The cables/cords are screwed into the needles, allowing the knitter to have both flexible straight needles or circular needles. This also allows the knitter to change the diameter and length of the needles as needed. The needles must be screwed on tightly, otherwise yarn can snag and become damaged.



Circular knitting needles in different lengths, materials and sizes, including plastic, aluminum, steel and nickel-plated brass

The ability to work from either end of one needle is convenient in several types of knitting, such as slip-stitch versions of double knitting. Circular needles may be used for flat or circular knitting.

Cable needles are a special case of DPNs, although they are usually not straight, but dimpled in the middle. Often, they have the form of a hook. When cabling a knitted piece, a hook is easier to grab and hold the yarn. Cable needles are typically very short (a few inches), and are used to hold stitches temporarily while others are being knitted. When in use, the cable needle is used at the same time as two regular needles. At specific points indicated by the knitting pattern, the cable needle is moved, the stitches on it are worked by the other needles, then the cable needle is turned around to a different position to create the cable twist.

Julia Hopson with world-record 3.5 meter (11'6") long knitting needles

Cable needles are a specific design, and are used to create the twisting motif of a knitted cable. They are made in different sizes, which produces cables of different widths.

- **Largest circular knitting needles**

The largest aluminum circular knitting needles on record are size US 150 and are nearly 7 feet tall. They are owned by Paradise Fibers and are currently on display in the Paradise Fibers retail showroom.

- **Record**

The current holder of the Guinness World Record for Knitting with the Largest Knitting Needles is Julia Hopson of Penzance in Cornwall.

Julia knitted a square of ten stitches and ten rows in stockinette stitch using knitting needles that were 6.5 centimeters (2½") in diameter and 3.5 meters (11'6") long.

- **Ancillary tools**

Various tools have been developed to make hand-knitting easier. Tools for measuring needle diameter and yarn properties have been discussed above, as well as the yarn swift, ballwinder and "yarntainers". Crochet hooks and a darning needle

Some ancillary tools used by hand-knitters. Starting from the bottom right are two crochet hooks, two stitch holders (like big blunt safety pins), and two cable needles in pink and green. On the left are a pair of scissors, a yarn needle, green and blue stitch markers, and two orange point protectors. At the top left are two blue point protectors, one on a red needle.

are often useful in binding/casting off or in joining two knitted pieces edge-to-edge. The darning needle is used in duplicate stitch (also known as Swiss darning). The crochet hook is also essential for repairing dropped stitches and some specialty stitches such as tufting. Other tools such as knitting spools or pom-pom makers are used to prepare specific ornaments. For large or complex knitting patterns, it is sometimes difficult to keep track of which stitch should be knit in a particular way; therefore, several tools have been developed to identify the number of a particular row or stitch, including circular stitch markers, hanging markers, extra yarn and row counters. A second potential difficulty is that the knitted piece will slide off the

tapered end of the needles when unattended; this is prevented by "point protectors" that cap the tapered ends. Another problem is that too much knitting may lead to hand and wrist troubles; for this, special stress-relieving gloves are available. In traditional Shetland knitting a special belt is often used to support the end of one needle allowing the knitting greater speed. Finally, there are sundry bags and containers for holding knitting, yarns and needles.

- **Knitting styles/holds**

- **Continental/German style**

Continental knitting is achieved by holding the yarn in your left hand for both knitting and purling. Patterns are created on the outside (public-facing) side of the piece.

- **Norwegian style**

While knit stitches are worked as in the classic Continental style, the purl is worked by leaving the yarn at back and moving the needle.

- **Russian style**

Another variation on Continental knitting, this style is achieved by "picking" up the yarn by moving the needle head into it. Now wrap the yarn around the index finger on that left hand, so it's coming over the top of your finger and back around underneath it and on top of your middle finger. You'll wind up with your index finger very close to the back of your left-hand needle. In Russian knitting, it is common to slip the first stitch of every row.

- **English style**

English-style knitting is achieved by holding the yarn in your right hand. Patterns are created on the outside (public-facing) side of the piece.

- **Portuguese/Greek/Incan/Turkish style**

This style is achieved by carrying the yarn around the neck or from a necklace-style hook, allowing the knitter to knit on the reverse (purl) side, e.g. "inside out" compared to Western knitting techniques. Patterns are typically created by stranding the yarn on the outside of the piece. This is an ancient style of knitting, which spread from Arabic culture to the Iberian peninsula, during its occupation by Muslims. Hence this style was taught to Indigenous South Americans, during conquest by Spanish/Portuguese colonists.

- **Knitting techniques**
- **Armenian**

The Armenian knitting technique tacks the non-working yarn to the piece regularly to limit floats. You will tack your non-working yarn down approximately every 3 stitches.

- **Fair Isle**

A method by which many different yarns are used throughout the row and when not being used are floated on the wrong side of the piece.

- **Mega knitting**

Mega knitting is a term recently coined and relates to the use of knitting needles greater than or equal to half an inch in diameter.

Mega knitting uses the same stitches and techniques as conventional knitting, except that hooks are carved into the ends of the needles. The hooked needles greatly enhance control of the work, catching the stitches and preventing them from slipping off.

It was the development of the knitting machine that introduced hooked needles and enabled faultless, automated knitting. The hook catches the loop of yarn as each stitch is knitted, meaning that wrists and fingers do not have to work so hard and there is less chance of stitches slipping off the needle. The position of the hook is most important. Turn the left (non-working) hook to face away at all times; turn the right (working) hook toward you up whilst knitting (plain stitch) and away whilst purling.

Mega knitting produces a chunky, bulky fabric or an open lacy weave, depending on the weight and type of yarn used.

- **Micro knitting**

Micro knitting or miniature knitting uses extremely fine threads and needles. **Anthea Crome** created 14 tiny sweaters used in the stop motion animated film Coraline and has made objects at 60 or 80 stitches per inch, making her own needles from fine surgical steel wire. She has published Bugknits: Extreme knitting for hobbyists, artists and knitters (2009, Blurb: ISBN 978-1320025546). **Annelies de Kort** has knitted on an even smaller scale and has used needles of 0.4mm.

- **Short row**

In short row knitting, the work is turned before a row is fully knitted. There are several ways to achieve this.

- **Wrap and turn**

Just before the work is turned, the working yarn is passed around the next unknitted stitch, forming a "wrap." Later, this "wrap" is picked up and knitted into a stitch, concealing it from view.

- **German short row**

In German short rows, the work is turned and the last stitch worked is slipped purlwise with yarn in front to the right needle. Finally, the working yarn is pulled over the top of the needle to the back, which rotates the stitch on the needle so that it tips backwards, forming what appears to be a double-stitch, sometimes referred to as a "German double stitch". The working yarn stays to the back for the next stitch if it is to be knitted, or rotated below the right needle and pulled to the front, if it is to be purled, both of which maintain the proper ("tipped back") orientation of the German double stitch. Eventually, this German double stitch is worked like a single stitch, which masks its appearance as viewed from the right side to look like a regular stitch.

- **Japanese short row**

In Japanese short rows, a locking stitch marker is used to hold the loop of the working yarn at the turning point. Eventually, the loop is picked up (and stitch marker removed) and worked together with the stitch on the other side of the gap. Japanese short rows usually result in tidier turning points with less extraneous yarn bulk compared to German short rows and the Wrap and Turn technique.

- **Commercial applications**

Industrially, metal wire is also knitted into a metal fabric for a wide range of uses including the filter material in cafetieres, catalytic converters for cars and many other uses. These fabrics are usually manufactured on circular knitting machines that would be recognized by conventional knitters as sock machines.
Many fashion designers make heavy use of knitted fabric in their fashion collections. Gordana Gelhausen, who appeared in season six of the television show Project Runway, is primarily a knit designer. Other designers and labels that make heavy use of knitting include Michael Kors, Fendi, and Marc Jacobs.
For individual hobbyists, websites such as Etsy, Big Cartel and Ravelry have made it easy to sell knitting patterns on a small scale, in a way similar to eBay.

- **Graffiti**

In the 2000s, a practice called knitting graffiti, guerilla knitting, or yarn bombing—the use of knitted or crocheted cloth to modify and beautify one's (usually outdoor) surroundings—emerged in the U.S. and spread worldwide. Magda Sayeg is credited with starting the movement in the US and Knit the City are a prominent group of graffiti knitters in the United Kingdom.[30] Yarn bombers sometimes target existing pieces of graffiti for beautification. For instance, Dave Cole is a contemporary sculpture artist who practiced knitting as graffiti for a large-scale public art installation in Melbourne, Australia for the Big West Arts Festival in 2009. The work was vandalized the night of its completion. A new movie, shot by a Tasmanian filmmaker on a set made almost entirely out of yarn, was partially inspired by "knitted graffiti".

- **Yarn crawl**

Many major metropolitan cities across the US and Europe host annual Yarn Crawls. The event is typically a multi-day event that caters to all knitters, crochet and yarn enthusiasts that supports the local crafting community. Over the multi-day period, multiple local yarn and knit shops participate in the yarn crawl and offer up store discounts, give away free exclusive patterns, provide classes, trunk shows and conduct raffles for prizes. Participants of the crawl receive a passport and get their passport stamped at each store they visit along the crawl.

Traditionally those that get their passports fully stamped are eligible to win a larger gift basket filled with yarn, knitting and crochet goodies. Some local crawls also provide a Knit-Along (KAL) or Crochet-Along (CAL) where attendees follow a specific pattern prior to the crawl and then proudly wear it during the crawl for others to see.

- **Charity**

Drawing by Marguerite Martyn of two women and a child knitting for the war effort at a St. Louis, Missouri, Red Cross office in 1917

Hand knitting garments for free distribution to others has become common practice among hand knitting groups. Girls and women hand knitted socks, sweaters, scarves, mittens, gloves, and hats for soldiers in Crimea, the American Civil War, and the Boer Wars; this practice continued in World War I, World War II and the Korean War, and continues for soldiers in Iraq and Afghanistan. The Australian charity Wrap with Love continues to provide blankets hand knitted by volunteers to people most in need around the world who have been affected by war.
In the historical projects, yarn companies provided knitting patterns approved by the various branches of the armed services; often they were distributed by local chapters of the American Red Cross. Modern projects usually entail the hand knitting of hats or helmet liners; the liners provided for soldiers must be of 100% worsted weight wool and be crafted using specific colors.

Some charities teach women to knit as a means of clothing their families or supporting themselves.

Clothing and afghans are frequently made for children, the elderly, and the economically disadvantaged in various countries. Pine Ridge Indian Reservation accepts donations for the Lakota people in the United States. Prayer shawls, or shawls in which the crafter meditates or says prayers of their faith while hand knitting with the intent on comforting the recipient, are donated to those experiencing loss or stress. Many knitters today hand knit and donate "chemo caps," soft caps for cancer patients who lose their hair during chemotherapy. Yarn companies offer free knitting patterns for these caps.

Penguin sweaters were hand knitted by volunteers for the rehabilitation of penguins contaminated by exposure to oil slicks. The project is now complete.

Chicken sweaters were also hand knitted to aid battery hens that had lost their feathers. The organization is not currently accepting donations, but maintains a list of volunteers.

Originally started after the 2004 Indonesian tsunami, Knitters Without Borders is a charity challenge issued by knitting personality Stephanie Pearl-McPhee that encourages hand knitters to donate to Médecins Sans Frontières (Doctors Without Borders). Instead of hand knitting for charity, knitters are encouraged to donate a week's worth of disposable income, including money that otherwise might have been spent on yarn. Knitted items are occasional offered as prizes to donors. As of September 2011, Knitters Without Borders donors have contributed CAD$1,062,217.

Security blankets can also be made through the Project Linus organization which helps needy children.

There are organizations that help reach other countries in need such as afghans for Afghans. This outreach is described as, "afghans for Afghans is a humanitarian and

educational people-to-people project that sends hand-knit and crocheted blankets and sweaters, vests, hats, mittens, and socks to the beleaguered people of Afghanistan."
The knitters of the Little Yellow Duck Project craft small yellow ducks which are left for others to find, as a random act of kindness and to raise awareness of blood donation and organ donation. The project was started in memory of a young woman who had collected plastic toy ducks and who died from cystic fibrosis while waiting for a lung transplant. Finders of the ducks are encouraged to log them on a website, which as of May 2020 shows that 12,265 ducks have been found in 106 countries.

- **Health benefits**

Studies have shown that hand knitting, along with other forms of needlework, provide several significant health benefits. These studies have found the rhythmic and repetitive action of hand knitting can help prevent and manage stress, pain and depression, which in turn strengthens the body's immune system, as well as create a relaxation response in the body which can decrease blood pressure, heart rate, help prevent illness, and have a calming effect. Pain specialists have also found that hand knitting changes brain chemistry, resulting in an increase in "feel good" hormones
(i.e. serotonin and dopamine) and a decrease in stress hormones.
Hand knitting, along with other leisure activities, has been linked to reducing the risk of developing Alzheimer's and dementia by preventing memory loss. Much like physical activity strengthens the body, mental exercise makes the human brain more resilient. It is wonderful to have a resource like knitting to have because it can be done anywhere. It is easy to do anywhere and has minimal materials and props to carry around with you, making it a very pleasurable and simple hobby that gives wonderful benefits.
A repository of research into the effect on health of hand knitting can be found at Stitch links, an organization founded in Bath, England.
Knitting also helps in the area of social interaction; knitting provides people with opportunities to socialize with others. Some ways to increase social interaction with knitting is inviting friends over to knit and chat with each other. Even if they've never knitted before this can be a fun way to interact with friends. Many public libraries and yarn stores host knitting groups where knitters can meet locally to engage with others interested in hand crafts.
Another interesting way that knitting can positively impact one's life is improving the dexterity in your hands and fingers. This keeps the fingers limber and can be especially helpful for those with arthritis. Knitting can reduce the pain of arthritis if people make it a daily habit.

- **Notable knitters**

Cat Bordhi - pioneered teaching new and efficient knitting techniques
Kaffe Fassett - American-born, British-based artist known for his colorful designs in the decorative arts
Stephanie Pearl-McPhee - is a writer, knitter, and knit-wear designer
Magda Sayeg - creator of Knitta Please knit graffiti movement
Barbara G. Walker - author of several encyclopedic knitting references
Stephen West - American knitter, fashion designer, educator, and author known for his knitting patterns and strong use of color
Elizabeth Zimmermann - British-born hand knitting teacher and designer

Dye : Dyeing

Dyeing

Dyeing is the application of dyes or pigments on textile materials such as fibers, yarns, and fabrics with the goal of achieving color with desired color fastness. Dyeing is normally done in a special solution containing dyes and particular chemical material. Dye molecules are fixed to the fiber by absorption, diffusion, or bonding with temperature and time being key controlling factors. The bond between dye molecule and fiber may be strong or weak, depending on the dye used. Dyeing and printing are different applications; in printing, color is applied to a localized area with desired patterns. In dyeing, it is applied to the entire textile.

The primary source of dye, historically, has been nature, with the dyes being extracted from animals or plants. Since the mid-19th century, however, humans have produced artificial dyes to achieve a broader range of colors and to render the dyes more stable to washing and general use. Different classes of dyes are used for different types of fiber and at different stages of the textile production process, from loose fibers through yarn and cloth to complete garments.

Acrylic fibers are dyed with basic dyes, while nylon and protein fibers such as wool and silk are dyed with acid dyes, and polyester yarn is dyed with disperse dyes. Cotton is dyed with a range of dye types, including vat dyes, and modern synthetic reactive and direct dyes.

What is object dyed?

These grey derby's have been treated after their construction with a unique dyeing technique Poell coined as, “Object Dyeing.” The creasing and subtle color **changes** to the leather are characteristics brought upon by this unique treatment.

What is dye ? Classification of dye

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Organic coloured substance that has the properties of fixing itself on the substrate to give it permanent coloured appearance and when fixed is not fugitive e.g. fast to light

and not washable by water, dilute acid or alkali is called dye.Dye is usually in the form of aquous solution.

History of Dyeing

The first dyes were Turkey red and indigo blue. A breakthrough event in the production of dyes was the chemical synthesis of aniline purple carried out by William Henry Perkin in 1856. For the purpose of the synthesis, benzene was nitrated to nitro-benzene and then reduced to aniline, which was further oxidized.

Classification of dyes
Chemical classification of dyes

1)Nitro dyes

2)Nitraso dyes

3)Azo dyes

4)Diphenyle methane dyes

5)Triphenyle methane dyes

6)Xanthan dyes

7)Diphenyl amine dyes

8)Heterocyclic dyes

9)Sulpher dyes

10)Pthalocyanin dyes

11)Anthraquinoid dyes

Dyers classification

1. Acid dyes

2. Basic dyes

3. Direct dyes

4. Vat dyes

5. Developed dyes

6. Sulphur dyes

7. Mordant dyes

Requisites of a dye:

1. It must have a stable colour.

2. It must have attractive colour.

3. It must be attached itself to material form solution or to be capable to fixation it.

4. It must be soluble in the application media.

5. The substrate to be dyed must have a natural affinity for an appropriate dye and must be able to absorb it form solution of concentration, temperature and pH.

6. When a dye is fixed to a substrate it must be fast to washing, dye cleaning, perspiration, light, heat and other agencies

7. The shade and fastness of a given dye may vary depending of the substrate due to different interactions of the molecular orbital of the dye with the substrate.

Objective of dyeing

1. To provide colour.

2. To obliterate the surface.

3. To develop newer design as per the market requirement

4. To improve the weathering properties and durability.

Acid dyes:

Acid dyes are generally sodium or potassium salts of organic coloured acid and ionize in solution as follows

$NaD = Na^+ D^-$ (Coloured acid)

Basic dyes:

Basic dyes are generally chlorides or hydrochlorides of coloured bases and ionize in the solution as follows

$BCl = B^+ + Cl^-$

Direct dyes:

Direct dyes are also sodium or potassium salts of coloured acid and behave the same ways as acid dyes. This dyes can directly used to impart colour to the fabric and hence the name.

$NaD = Na^+ + D^-$

Vat dyes

Vat dyes are suitable for cotton dyeing. These dyestuffs are insoluble in water but when reduced in an alkaline medium become soluble but practically colourless. The colour again restored on oxidation by the atmospheric air or nay suitable oxidizing material.

Before dyeing the dye solution called a vat, is prepared by dissolving the dyestuff in lukewarm water containing caustic soda and reducing agent. Then the material to be dyed is impregnated with this solution, it is squeezed and hung up for oxidation to develop colour. For heavy colour the procedure may have to be repeated several times.

Preparation of leather for dyeing

Splitting, shaving, washing and degreasing in some case in order to remove the still remaining material greases and where necessary wetting back which is practiced in retanning of suede's, nubacks splits.

The next preparatory operation considered to be the most important is the adjustment of an appropriate pH or the ionic charge in the leather in order to suit the subsequent retanning operation to be followed. For chrome or mineral tanned leather the process is known as neutralization, is the removal of protein bound acid from the surface as well as interior of leather up to certain depth depending on penetrating material used in the retanning system.

For vegetable tanned leather the preparatory wet operation for adjustment of suitable pH or ionic charge in the leather starts from acidification which commences after usual washing or stripping and degreasing where necessary.

Dyeing off 100% cotton knit fabric with reactive dye.

Asif Ahmed Safwan-18:39
Experiment name : Dyeing off 100% cotton knit fabric with reactive dye.

Theory: Nowadays reactive dyes are very popular for textile coloration because of its some specific properties like colour fastness, wide range of shade, brilliance of shade and simple application procedure. It reacts with fibre in presence of alkali and adheres as a part of fibre.

Objective:

1. To learn about dyeing process of cotton fabric by reactive dye.
2. To dye cotton fabric by reactive dye.

Nature of sample:

Pre-treated 100% cotton knit fabric.

Apparatus required:

1.Beakers
2.Glass Rod.
3.Pipette.
4. Measuring Cylinder.
5. Digital Balance.
6. Tri-pod stand.
7. Gas Burner.
8. Thermometer.
9. Pot.

Process sequence

- Collection of pre-treated sample
- Set water level
- Add leveling agent
- Add dye solution
- Add salt solution'
- Add soda ash solution
- Add fabric sample
- Raise the temperature to 60deg C
- Run time for 30 minute
- Bath drop
- Rinsing
- Hot wash at 90deg for 10 minute
- Dry

Table1: Dyeing Recipe

SL	Process Parameter	Unit	Dossing	Stock soln:
01	Levelling Agent	g/L	1	1%
02	Dyes	%	2	1%
03	Glauber Salt	g/L	40	15%
04	Soda Ash	g/L	10	10%
05	Sample Weight	gm	5	---
06	M:L	-----	1:30	---
07	Temperature	degC	60	---
08	Time	min	20	----

Calculation:

Total Liquor = Fabric weight X L [M:L = 01:30]
= 5 X 30
= 150mL

Dye 2% = (Fabric weight X x%) / stock solution%
= (5X2%) / 1%
=10mL

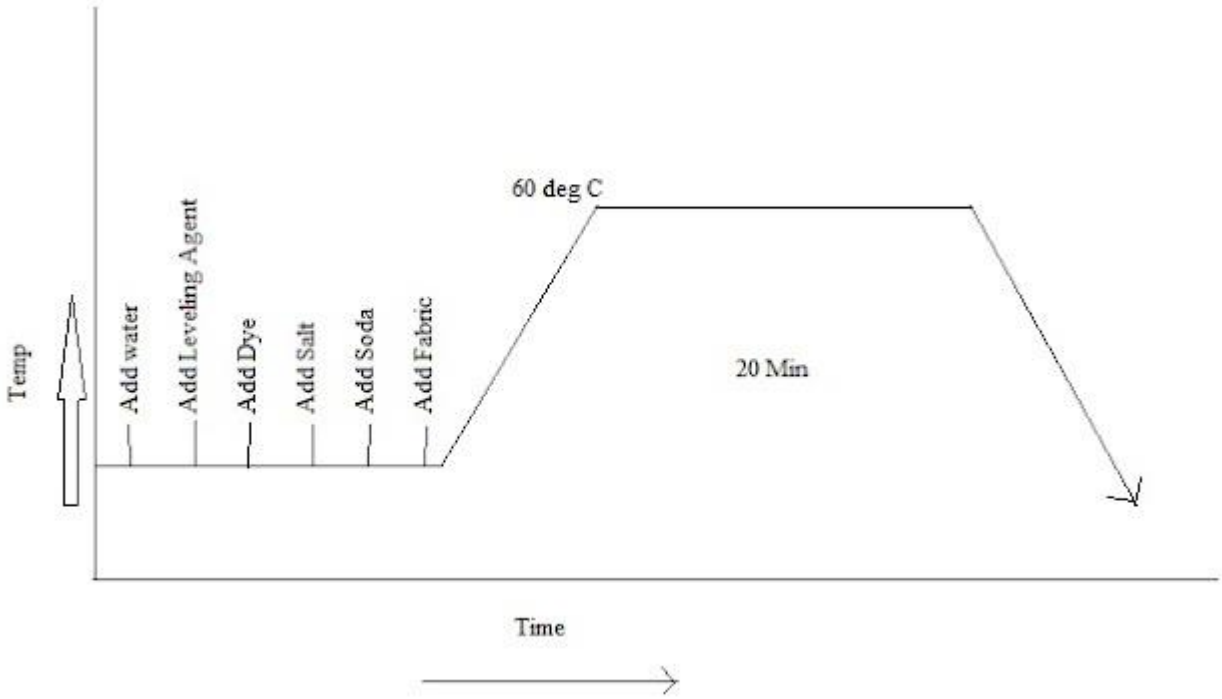
Levelling Agent = (Total liquor X 'x'g/L) / (stock solution% X 1000)
= (150 X 1) / 1% X 1000
= 15ml

Glauber Salt = (Total liquor X 'x'g/L) / (stock solution% X 1000)
= (150 X 40) / 15% X 1000
= 40mL

Soda Ash = (Total liquor X 'x'g/L) / (stock solution% X 1000)
= (150 X 1) / 1% X 1000
= 15ml

Initial Water = total liquor - (chemical 1 + chemical 2 + chemical 3 ...)
= 150- (15+40+15+10) mL
= 150 -80 mL
= 70mL

Process Curve:



Sample Attachment:

Standardization of recipe for dyeing

SHARE

'Standardization of Recipe for Dyeing Staining Free Polyester/Cotton Blended Yarns'

1) Abstract:

Disperse dyes give excellent overall fastness properties with polyester where it gives very poor fastness properties with cellulose. The reason behind this is disperse dyes does not have any substantivity & affinity towards cotton & cotton cannot be dyed at very high temperature as like Polyester. Hence P/C blend dyeing will not give sufficient fastness properties compared to 100% Polyester. Normally in industries a recipe used for dyeing 100% Polyester is also applied for different proportions of P/C blends and then it is topped up with reactive dyes to match the shade. But it will not give sufficient fastness properties.

The object of the work is to standardize (P/C blend worked out with three different proportions) and to formalize the individual recipe for each proportions to improve the fastness properties of blended fabrics.

2) Introduction:

100% PET means for strength, crease resistance but it cannot be wearable because of low moisture content, static generation and accumulation, so P/C blend enters in market because it has a advantages of both PET and cellulose and can be wearable.

PET cotton blend has got lot of advantages from user point of view but from dyers point of view it was difficult to dye the blends. P/C blends does not give sufficient fastness properties as like 100% PET with disperse dyes. In industries, single recipe used for 100% PET is also applied for different proportions of P/C blends & then it was topped up with reactive dyes to match the standard shade. But the fastness properties of these blend is a big question mark. While using disperse dyes for dyeing P/C blends, it is noticed that the PET portion is not only dyed but not the cellulosic portion. It only stains the cellulosic portion. So the overall fastness properties of P/C blend fabrics is going to be less and also the staining of disperse dyes on cotton is more.

In our work, we are going to dye three different proportions of P/C blends with disperse dyes and reactive dyes. Here, we change the procedure of dyeing P/C blend which are in practice in order to standardize the individual recipe for each proportion by using disperse dyes and reactive dyes.

3) Materials & Methods:

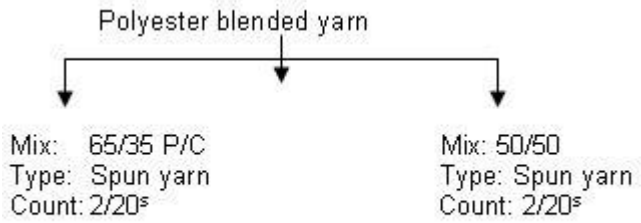
In our work, we have taken p/c blends yarns since p/c blended fabrics are mostly used for wearable purpose

3.1 Material:

1. 100% polyester yarn

Type : spun yarn

Count : 20^{s}



2.

3.2 Dyes Used:

Dyes Manufacturer: CIBA

Disperse dyes:

i. Dark red 2B
ii. Scarlet RR

Reactive Dyes:

i. Red F3B
ii. Yellow MERL
iii. Blue BBID

3.3 Chemical and Auxiliaries

i. Acidic Acid
ii. Ammonium Sulphate
iii. Soda
iv. Salt
v. Anionic Soap

Acidic Acid:

Manufacturer - Parrys India (p) Ltd.,

Concentration - 100%

Purity - 99%

Ammonium Sulphate:

Manufacturer - Parrys India (p) Ltd.,

Concentration - 100%

Purity - 95%

Soda

Manufacturer - TATA Chemical (p) Ltd.,

Concentration - 100%

Purity - 95%

Salt

Manufacturer - TATA Chemical (p) Ltd.,

Concentration - 100%

Purity - 95%

3.3. Methods

The grey polyester cotton blend yarn is followed with following recipe and it is neutralized with Acetic Acid at room temperature.

H_2O_2 - 2 gpl

Na_2CO_3 - 2 gpl

Wetting Agent - 1 gpl

Temperature / Time - Boiling Temp / 30 min.

Then the work is made with different recipe as follows. The polyester cotton yarn of different blend is dyed with the same amount of disperse dyes as follows:

100% polyester

Dark Red 2B - 1.8 %

Scarlet RR - 0.93%

Ammonium Sulphate - 3g

Acetic acid - 0.3%

Polyester / Cotton blend - 52 / 48

Dark Red 2B - 1.8 %

Scarlet RR - 0.93%

Ammonium Sulphate - 3g

Acetic acid - 0.3%

Polyester/cotton blend 65 / 35

Dark Red 2B - 1.8 %

Scarlet RR - 0.93%

Ammonium Sulphate - 3g

Acetic acid - 0.3%

Anionic Soap

Manufacturer - Clariant Chemicals (p) Ltd.,

Concentration - 100 %

Purity - 100 %

4) Dyeing Procedure

The dye bath is set with

1g/liter - Dispersing agent

0.5 g/liter - Wetting agent / leveling agent (optional)

The redox buffer is added and the pH is adjusted to 5.5. The liquor is circulated through the package at 50C for.15 min. The dyes are dispersed in 10 to 20 times in the weight of water at 45-50C. The dispersion is filtered through a thin cloth into the dye bath. The liquor is circulated and the temperature raised to l30°C in 30-min (The-pump pressure is slightly higher than the static pressure. (Dyeing is continued for 40-60 min). The dye-liquor is circulated inside-out throughout the whole dyeing cycle so that the position of the fabric is not disturbed. The flow of liquor may be from inside out for 10 min to outside-in for 10 min in every 10 min to get very uniform results. After about 40 min, a sample is taken out for the shade matching. The liquor is cooled to 80-90C and before shading disperse-dye liquor is added to avoid uneven dyeing. On completion of dyeing, the dye bath is drained at the highest possible temperature Otherwise the shade appears bronzy because of the deposited ash like oligomer powder that may dust off and create problems in finishing The precipitated dyes are difficult to remove from the PET surface and the lower the rubbing fastness of dyed goods. Thus, the bath must be dropped the dyeing temperature (or) as near to that temperature as possible. However, there are difficulties in dropping the bath (which is under pressure). Since, lot of steam is generated when the hot liquor comes to atmospheric pressure. Special arrangements are usually made to take care of this problem, and dropping in soaping of the material is washed, reduction-cleared, and soaped.

5) Recipe for Shade Matching:

The following recipes are used for topping up the polyester / cotton blend with reactive dyes to match the shade.

P/C blend P/C blend

(65 / 35) (52 / 48)

Red F3B - 3.4 % Red F3B - 5%

Yellow M3RL	- 1.6%	Yellow M3RL	- 1.6%
Blue BBID	- 0.1%	Blue BBID	- 0.1%
Salt / Soda	- 14g / 3 g	Salt /Soda	- 14g /3 g

Dyeing **Procedure:**

The dye bath is setup with required amount of dyes at RT. After 10 min, required amount of salt is added. Raise the temperature to 60°c. Dyeing is carried out for 20 min. Then soda ash of required quantity is added. Continue the dyeing for 90 min and then after treatment is given.

6) Standardized Recipe:

Here, the disperse dyes are standardized according to the proportion of the polyester portion in polyester / cotton blend.

100% polyester

Dark Red 2B - 1.8 %

Scarlet RR - 0.93%

Ammonium Sulphate - 3g

Acetic acid - 0.3%

P/C blend 65 / 35

Dark Red 2B - 1.1 %

Scarlet RR - 0.5%

Ammonium Sulphate - 3g

Acetic acid - 0.3%

P/C blend 52 / 48

Dark Red 2B - 0.9 %

Scarlet RR - 0.4%

Ammonium Sulphate - 3g

Acetic acid - 0.3%

Then it is taken for reduction clearing.

Reduction Clearing:

Caustic - 2 gpl

Hydrose - 2 gpl

Cyclone ECO - 1 gpl

Temperature - 80° C

Time - 15 min

7) Standardized Recipe for Cotton

The standardized recipe for cotton portion by using reactive dyes is given below followed by after treatment

P/C blend 65 / 35 P/C blend 52 / 48

Red F3B - 7.8 % Red F3B - 5.2%

Yellow M3RL - 4.1% Yellow M3RL - 3.0%

Blue BBID - 2.4% Blue BBID - 1.6%

Salt - 16g Salt - 16g

Soda - 5g Soda - 5g

8) Results and Discussion

Based on the inference of our work the following results are obtained, which are tabulated below.

Table 8.1: Comparison of light fastness results of conventional dyed and standardized dyed samples

S.No.	Blends	Hours	Conventional Dyeing	Standardized Dyeing
1.	100 % PET	20	4-5	4-5
2.	65-35 P/C	20	4	4-5
3.	50-50 P/C	20	4	4-5

Table 8.2: Comparison of rubbing fastness results of conventional dyed and standardized dyed samples

S.No.	Blends	Conventional dyeing		Standardized dyeing	
		Dry	Wet	Dry	Wet
1.	100 % PET	4-5	4-5	4-5	4-5
2.	65-35 P/C	4	3-4	4-5	4-5
3.	50-50 P/C	4	3-4	4-5	4-5

Table 8.3: Comparison of sublimation fastness results of conventional dyed and standardized dyed samples

Conventional dyeing

	100% p Yarn Red colour	**P/C 65-35 Red colour**	**P/C 50-50 Red colour**
Time (seconds)	120	120	120
Temperature (Deg.C)	120 + 2	120+2	120+2
Staining on wool	4-5	4	3-4
Acrylic	4-5	4	3-4
Polyester	4-5	4	4
Nylon	4-5	4	3-4
Cotton	4-5	4	3
Acetate	4-5	4	3-4

Standardized dyeing

	100% p Yarn Red colour	**P/C 65-35 Red colour**	**P/C 50-50 Red colour**
Time (seconds)	120	120	120
Temperature (Deg.C)	120 + 2	120+2	120+2
Staining on wool	4-5	4-5	4-5
Acrylic	4-5	4-5	4-5
Polyester	4-5	4-5	4-5
Nylon	4-5	4-5	4-5
Cotton	4-5	4-5	4-5
Acetate	4-5	4-5	4-5

Table 8.4: Comparison of washing fastness results of conventional dyed and standardized dyed samples

S.No.	Blends	Conventional dyeing		Standardized dyeing	
		Change in shade	Staining on cotton	Change in shade	Staining on cotton
1.	100 % PET	4-5	4-5	4-5	4-5
2.	65-35 P/C	4-5	3-4	4-5	4-5
3.	50-50 P/C	4-5	3	4-5	4-5

Light, Rubbing, Sublimation and Wash Fastness are found to be excellent in the standardized method samples when compared to normal dyeing method.

9) Conclusion

Washing fastness, light fastness, sublimation and rubbing fastness of 100% PET are excellent in 100% polyester. Fastness properties like wash, light, rubbing and sublimation properties was reduced to10-15% compared to 100% Polyester . Disperse dyes stains on cellulose to a greater extent in P/C blends to that of 100% Polyester in Normal Method.

In Standardized Method, wash fastness, light fastness and all other fastness properties was proved to be excellent in 100% Polyester. Based on the above results, we conclude that by standardizing the recipe for each proportions, fastness properties of the fabric was increased and we can achieve stain free dyeing P/C blended yarns.

This work can be tried in all other classes in reactive dyes, since reactive dyes mostly have affinity and substantivity with cellulose. This work can be extended in other fibre blends like P/V, P/W.The work can be modified by varying the parameters like time, temperature and concentration. This project consumes more reactive dyes compared to normal method. This can be tailor made by selecting proper concentration. We work the material in two bath process. Other modes of application (i.e.,) one bath process, can also be tried.

10) References

1) LS super fast dyeing, finishing and thermo migration - Ciba Dyes and Chemicals.

2) Keshav V. Datye and Vaidya- "Chemical processing of synthetic fibres and blends" - pp. 183-190.

3) A.Adwin Sunder M.Tech.- "Quality Assurance in Textile Wet Processing" - pp. 57-61 & 67-73.

About the Author:

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Working process in dyeing lab:

1. The standard fabric is checked in the spectrophotometer, which gives us a prediction recipe.
2. According to the prediction recipe dyes are prepared in a dispenser.
3. Then the caustic and chemicals are added to the dye and mixed properly.
4. After that the fabric is padded through the roll

Dyeing Lab:

Dyeing lab is the heart of the dyeing factory. Lab dip development is done in dyeing lab. We know from the previous article, **lab dip** is a particular garment style, containing many shades of the fabric color which the buyer is asked have to be sent to the buyer for the approval before going for further production. Higher precision lab can aid easily to achieve the goal of the dyeing mill. Before bulk production a swatch of fabric test dyed to hit a color standard. It is a process by which buyer's supplied swatch is matched with the varying dyes percentage in the laboratory with or without help of spectrophotometer. For doing all tests different equipment's are used in dyeing lab. In this article I will discuss different aims of dyeing lab, working process of dyeing lab and also different types of machines those are used in dyeing lab.

Fig: Dyeing laboratory

Aims or Purposes of Dyeing Lab:
The main aim of dyeing lab is:

1. Color match prediction
2. Color difference calculation
3. Determine metamerism
4. Pass/Fail option
5. Color fastness rating
6. Cost comparison
7. Strength evaluation of dyes
8. Whiteness indices
9. Reflectance curve and K/S curve
10. Production of shade library
11. Color strength

Machine Requirements in Dyeing Lab:

1. CCM (Computer color matching) Software used: Color i7
2. AGS Macbeth Spectralight-III
3. 2 Roll laboratory padder [Vertical + Horizontal] by Mathis
4. Laboratory steamer by Mathis
5. Dispenser by Tecnorama
6. Infrared (IR) Lab Dyeing Machine
7. High Temperature Lab Dyeing Machine
8. Oscillation Dyeing Machine
9. Lab Jig Dyeing Machine
10. GyroWash etc.

List of Tests are Done in Dyeing Lab:
Testing process in dyeing lab are divided in three classes.

1. Physical Testing
2. Lab Dip/Chemical Tests
3. Mechanical Test

1. Physical Tests

- **GSM**
- Fiber Diameter
- Ends per inch
- Linear Density

2. Chemical Tests

- PCP
- Blend composition
- **Identification of Textile Fiber**
- Identification of Dyes
- Solvent Extractable matter
- Chloride Content
- Sulphate Content
- pH value of water extract
- Moisture Content
- Shrinkage to Water
- Colour Fastness Tests

3. Mechanical Test

- Tensile Strength and Elongation
- Breaking Strength
- Bursting Strength of Paper
- Tear Strength
- Elmendorff Tear Strength
- Air permeability of Paper
- Pilling Test
- Dry and Wet Rubbing (Crock Meter)
- Ether Soluble Matter
- Water Absorbency
- Lead and its compounds
- Scouring loss
- Flammability

Generally below tests are done in dyeing lab:

1. Dimensional Stability to washing (Shrinkage)
2. Spirality/Twisting
3. **Colorfastness to washing**
4. Colorfastness to Water
5. Colorfastness to Perspiration
6. **Colorfastness to Rubbing/Crocking**
7. Colorfastness to Saliva

8. **Colorfastness to Actual Laundering**
9. Print Durability
10. Fabric Weight
11. **Thread Count**
12. Pilling Resistance
13. pH Test
14. Yarn Appearance
15. Yarn Count etc.

Process flow path of continuous process in dyeing lab:

Spectrophotometer

↓

Dispenser

↓

Dyeing (2 roll laboratory padder)

↓

E-control

↓

Soaping

↓

Dry

↓

Shade checking

*For CPB process after padding it is dried in hot air oven at 60°C- 120°C for 30 min. After 2- 3 seconds of fixation soaping is done followed by drying and shade checking.

Recipe for continuous process:

- M:L = 4:1 (Color: Chemicals)
- Soda= 12gpl
- Ceragel (wetting agent) = 2 gpl
- Anti- migrating agent (MIP) = 10 gpl
- Resist salt= 5 gpl

Working process in dyeing lab:

- The standard fabric is checked in the spectrophotometer, which gives us a prediction recipe.
- According to the prediction recipe dyes are prepared in a dispenser.

- Then the caustic and chemicals are added to the dye and mixed properly.
- After that the fabric is padded through the roller.
- After dyeing the sample is dried at 120°C for 2.44 min (the temp & time depend on the fabric quality) in a e-control.
- Then the fabric is washed in soaping machine and dried by iron.
- After that the dyed fabric is compared with the standard fabric in spectra light and spectrophotometer.

Process flow path of exhaust process in dyeing lab:

Spectrophotometer

↓

Dispenser

↓

Dyeing (exhaust process)

↓

Soaping

↓

Dry

↓

Shade checking

Recipe for exhaust process:

- MLR=1:10
- Dye used= (Wx P)/C

Where, W= weight of fabric
P= Shade%
C= Concentration of solution

- Glaubers salt= 50gpl
- Soda= 200 gpl

Machine used: Mathis

Machine speed: 50 rpm

Procedure for dyeing:

1. Fabric is put inside the tumbler with dye and salt for first 15 minutes at room temperature.

2. Then after the temperature reaches 60°c half of the soda is added and rotated for 45 minutes.
3. Then again other half of soda is added and rotated for 10 mins.
4. In this way it took total 70 minutes for dyeing of cotton.

After dyeing the fabric is checked for shade variation. It can be done through two ways:

1. Visually in Spectralight (AGS Macbeth Spectralight-III OX-rite)
2. Or in CCM using Color i7 software.

Spectralight has 6 lighting arrangement, according to sunrays received by Earth:

- Daylight 65 (D65)
- Horizon
- TL83 U30 (used for HNM)
- A10 (used for INCA)
- UV

You may also like: What is Shade in Textile | Fabric Shade Checking System in Textile Mill

Computer Color Matching (CCM) System:

- In computer color matching, we have to first make an attempt to quantify colors by virtue of a unique reflectance pattern that each color exhibits and then match this unique pattern by a blend of various dyes.
- The blend that gives an identical reflectance pattern is an exact match for the desired color.
- For this, we have to collect the spectral reflectance data for both the standard color and the dyes.

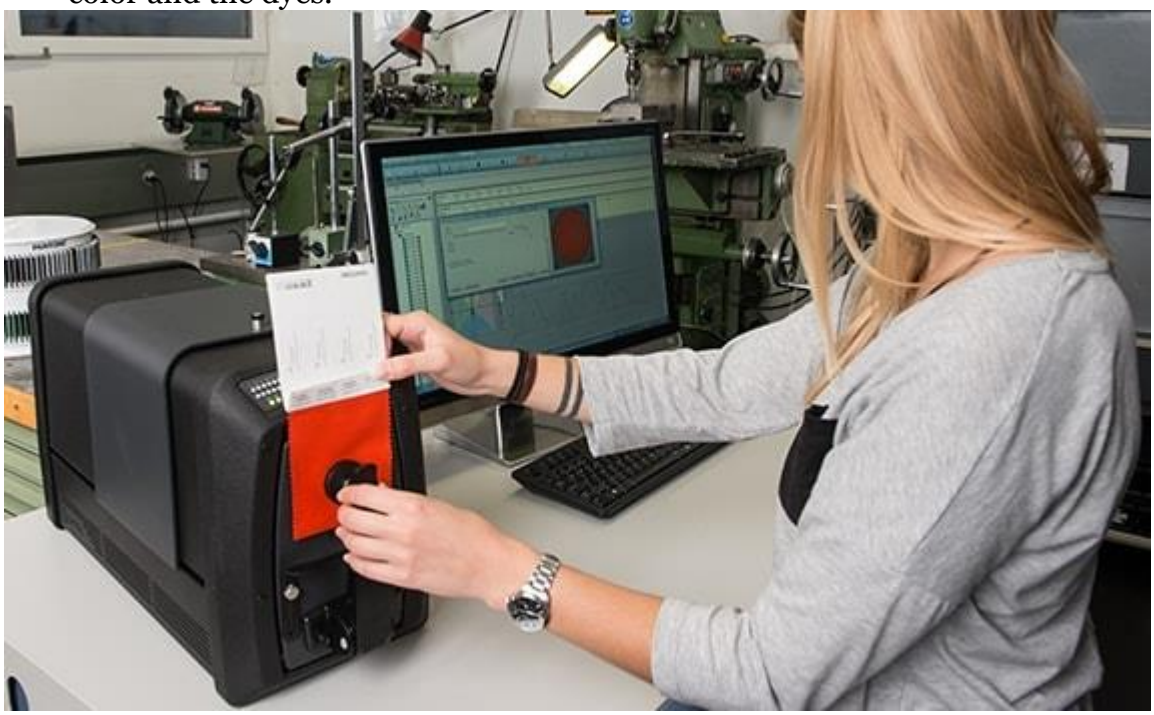

Fig: Computer color matching by spectrophotometer

This data is then to be analyzed by using Kubelka-Munk equation:

- K/S= [(1-r) 2 / 2r]
- Where r is the reflectance value of samples at a given wavelength,
- K/S= color strength

The basic three things of CCM are:

- Color measurement instrument (Spectrophotometer)
- Reflectance (R %) from a mixture of dyes
- Optical model of color vision

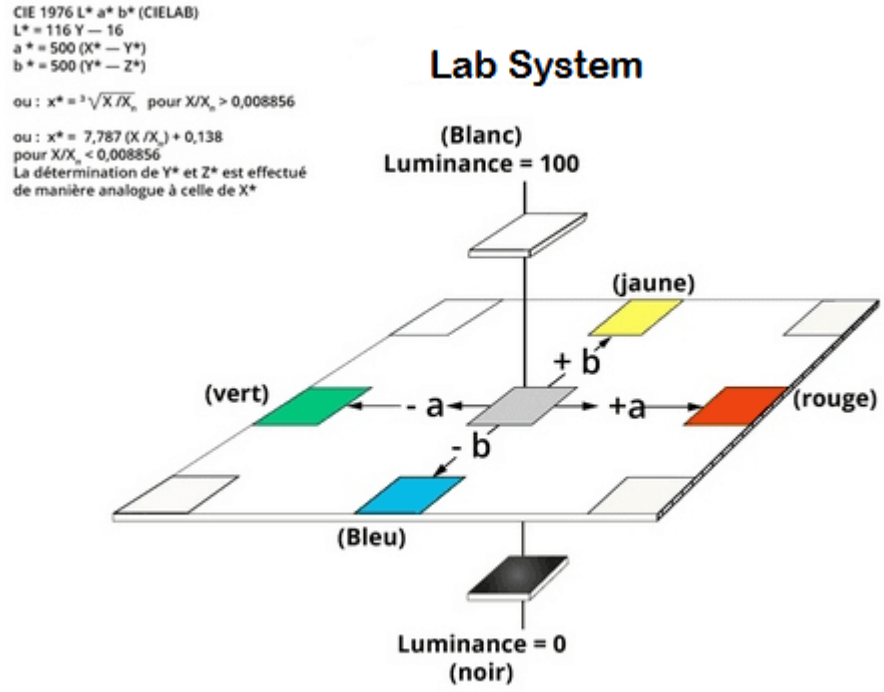

Fig: Lab system

This model gives us the L* a* b* value, from which we can calculate c*, h* and E.

Where,
L*= L Standard – L Sample
a* = a standard– a sample
b* = b standard–b sample and,
E = (L2 + a2 + b2)1/2

*If E is more than 1, then the result is declared as fail or the recipe is rejected.

*Also the color strength must be ±100, or else the recipe is rejected.

For example:

- We have dyed a lab-dip using Jakazol dyes in e-control process.
- Shade name: STD NAVY

Prediction recipe:

Jakazol Yellow CE= 4.50 gpl
Jakazol Red CE= 13.50 gpl
Jakazol Blue CE= 23.00 gpl

You may also like:

1. **Procedure of Lab Dip Development by the Different Dyestuff in the Laboratory**
2. **Objects and Process Sequence of Lab Dip in Dyeing Lab**
3. **Calculation and Working Procedure of Lab Dip in Textile Industry**
4. **What is Shade in Textile | Fabric Shade Checking System in Textile Mill**
5. **List of Chemical Testing Equipments for Dyeing Lab**
6. **List of Physical Testing Machines in Dyeing Lab**

Process Flow Chart of Lab Dyeing
December 21, 2015 by textile-flowchart
Lab Dyeing:

The lab is the heart of the textile industry higher precision lab can aid easily to achieve the goal of the organization. Before bulk production, a sample for the approval from industry is sent to the buyer as per the requirement of the buyer the shade is prepared in a lab dyeing considering the economical aspects.

Process Sequence of Lab Dyeing:

Swatch from Buyer

↓

Color Selection
(Depends on Buyer)

↓

Lab Dip

↓

Sent to Buyer for Approval

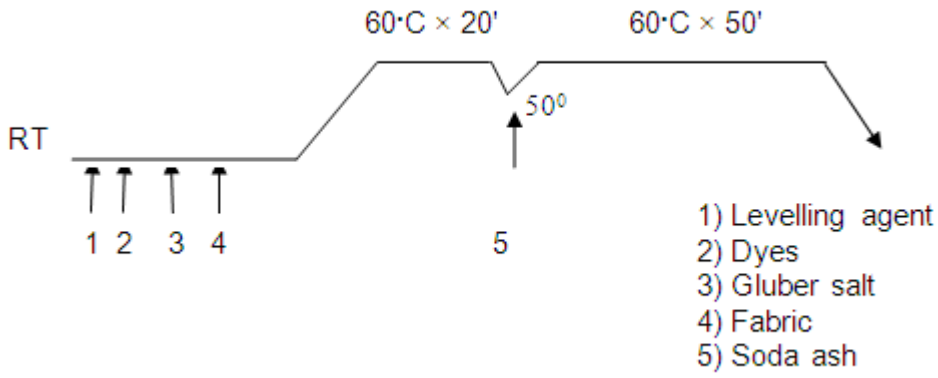

Fig: Lab dyeing

curve**Main Ingredients:**

1. Leveling agent
2. Dyes
3. Gulber Salt

4. Fabric
5. Soda Ash

Nowadays industry relies mostly on 'Lab to Bulk'. Through trial and error basis, which makes it difficult to maintain and achieving the Right Fast Time – RFT resulting in an increase in cost.

RFT achieving the desired color and quality in dyeing at once as per the standard predefined operating processes. In most cases, it is not easy to match all the batches maintaining RFT. As there are numerous factors that affect the performance of dyeing. That's why the dye-houses suffer from increasing RFT.

Concept of 'Bulk to Lab' dyeing

The dyeing laboratory has a great role in setting and achieving RFT. Basically, labs in dye-houses are used for generating lab recipes (usually called Lab Dip), color control, incoming raw materials quality control, in line and of line quality control, and so on. Generating a common recipe for dyeing is one of the objectives of the labs.

Although, it has been well accepted that there are potential differences in bulk and lab dyeing conditions. So dyers on the floors don't rely on the laboratory recipe much. Most of the time the dyeing experts in a factory trying to adjust the less reliable lab recipe from their experiences and go through some sort of trial. And error process in the bulk for setting a reliable bulk recipe that will give RFT 100%.

In this way, the companies try to improve traditionally the 'Lab to Bulk' recipe and RFT. The trial and error occurring in bulk production, even if those done in the sample and small machines, incurs a huge reduction in RFT hence resulting in less productivity.

A design thinking look on the issue is critically important as a good recipe from the lab is important for bulk dyeing to increase productivity and to reduce production cost. It is very important to maintain a good dyeing process in the bulk and the process has to be very reliable and easily controllable. The major work to achieve a reliable bulk process has to be done in a lab, not on the bulk floor.

Lab Dyeing Machine ACCDYER-24 /ACCDYER-18

Lab Dyeing machine is applicable for various materials, such loose fibers, yarn and pieces of fabric (knitted fabric and woven fabric) which suit for lab dyeing .
Follows are lab dyeing equipments specification :

- PLC controller to control temperature and LCD display;
- LED display of speed of rotating rack;
- New-designed electric heater, stable, durable and maximum heating power less than 2.5kW;
- Average power consumption less than 100W when compensation for heat preservation;
- 316L stainless steel beakers;
- Single-directional strong wind for cooling;
- Low liquor ratio up to 1:5;
- Be able to edit and store 100 programs and 100 steps per program;

You May Also Like...

High Temperature Data Logger LOG150

IR Dyeing Machine RHS-12/24

Textile Medium-Batch Dyeing Machine ACCDYER-12L / 23L

Dyeing Fabrics: Tips, Tricks, and How-Tos

Natural fibers—such as cotton, linen, silk, and wool—take dye much better than synthetics do. Dyeing is as much an art as a science, so don't hesitate to experiment. For example, we like combining liquid dyes to come up with our own colors. Modify this technique for items other than fabric, immersing them in the dye and taking note of how each item takes the color.

Fabric-Dyeing How-To

You don't have to start with white fabric-if you want to reinvent a colored item, try a color remover (similar to bleach, but non-damaging) before dyeing it. This will whiten or lighten the fabric so it can take on the new color.

1. Wash your fabric item if it is new. Cover work surface with a drop cloth. Fill a bucket, bin, or stainless steel sink (large enough to hold the fabric loosely) about halfway with very hot tap water or boiling water. (For wool, water should be warm, not hot.) Wearing rubber gloves, add liquid dye, mixing colors as desired (see Mixing Colors, right). Add salt if dyeing cotton or linen, or white vinegar for wool or silk; amount will depend on size of dye bath. We used ¼ cup of either salt or vinegar for a bath of about 1 gallon, ½ cup for 2 gallons, and 1 cup for 3 or more gallons. (These additions help the fabric take the dye.)

2. Thoroughly wet fabric (you can run large pieces through the washing machine's rinse cycle to wet them evenly) and immerse in dye bath. With a stainless steel spoon (or a wooden spoon reserved only for dyeing), move fabric around in water to avoid uneven dyeing. Keep item in dye 5 to 15 minutes, stirring the whole time. Allow fabric to get a little darker than you want it, as it will fade slightly with rinsing and drying.

3. Carefully remove fabric from dye and rinse in running water, starting with warm water and then making it cooler, until it runs clear. (You can also rinse the fabric in the washing machine's rinse cycle.) Wash out bucket, bin, or sink immediately.

4. Wash item with mild detergent on the cold cycle, then dry.

Rit color remover and liquid dyes, michaels.com

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Mixing Colors

Below are formulas for the colors shown, each using 1 quart of water and the specified amounts of Rit liquid dyes.

A. 1 teaspoon Fuchsia

B. 1 tablespoon Golden Yellow + 1 teaspoon Tan + ½ teaspoon Kelly Green

C. 1 tablespoon Scarlet + 2 teaspoons Petal Pink + ½ teaspoon Taupe

D. 2 teaspoons Petal Pink + ½ teaspoon Cocoa

E. 6 teaspoons Dark Green + 2 teaspoons Teal

F. 3 teaspoons Teal + 2 teaspoons Taupe

To scale up the dye-bath size, use more water, but don't increase dye amounts in the same proportions. For instance, the dark-green bedding uses formula E; we made a bath with about 30 gallons of water, 12 tablespoons of Dark Green dye, and 4 tablespoons of Teal dye. Generally, start with less dye, test on a paper towel, and add more as needed.

Tips & Tricks

CUSTOM COLORS

When coming up with your own shades, get the look you want without wasting dye by making a small dye bath first: Add the dyes to hot water in a large glass measuring cup, noting how much color you're adding. Test the color with a paper towel. When you have the hue you want, make the bath in a larger amount. (See Mixing Colors, above, for tips on increasing the size of the dye bath.)

SURPRISE RESULTS

You never know exactly how a material will take a color. A white napkin and an off-white napkin may not come out looking the same. Trim and stitching can take color differently than the base fabric does. And while dyeing is a great way to revive old, faded fabrics, it won't remove or even necessarily cover stains.

FOR LARGE ITEMS

When dyeing bedding and tablecloths, we used a large plastic bin set in a bathtub (to catch any drips) and brought in pots of water heated on the stove. It's especially important to keep the fabric moving while it sits in the dye bath; use a long spoon to carefully stir, lift, and redistribute it constantly. When the items reached the desired color, we lifted them out and placed them in another empty bin to take them to the washing machine, where we rinsed them on the rinse cycle.

WASHING DYED FABRICS

The first several times you wash dyed items, wash them alone to prevent bleeding-or add an old white washcloth or sock to see if the dye runs. Over time and with repeat washings, the color of the dye may fade-but remember, you can always dye them again

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Production Officer of Dyeing Finishing (Wet Processing -Home Textile)

- To supervise production as instructed by Manager.
- To give instruction operator/asst. ...
- Shade assessment during finishing process.
- To monitor and control the quality parameter.
- To change machine functions and processes parameter regarding quality.

Dyeing Calculation in Lab Dip

Dyeing Calculation:

At the initial stage of dyeing calculation, one needs to calculate the dyeing recipe the lap deep before going for bulk productions. For this, a lot of work is done in the dyeing laboratory. In the dyeing lab, lab dip or sample is developed by the dyeing master. Lab dip plays an important role in shade matching & this is an important task before bulk production. This article just for beginners who are entering into dyeing production the dyeing calculation in lab dip will help them.

Dyeing Calculation in Lab Dip

Sample recipe:

- Material weight = 5.0 gm
- Wetting agent = 0.5 g/l
- Sequestering agent = 2.0 g/l
- Antipilling agent = 1 g/k
- Dyes = 1.5%
- Glauber salt = 40 g/l
- Soda ash = 10 g/l
- M : L = 1 : 10

Stock Solution Concentration:

- Wetting agent, sequestering agent, and anti-pilling agent = 1.0%
- Dyes = 1.0%
- Salt, soda ash = 20%

Dyeing Calculation in Lab Dip

Dyeing Calculation:

1. Total amount of liquor = 5 X 10 = 50 ml

2. Required wetting agent = [{ Total liquor (lit) X Recipe amount in gm/l} / Stock solution%]
= [{(50 ml/1000 ml) X 0.5 g/l} / 1.0%]
= 2.5 ml

3. Required sequestering agent = [{ Total liquor (lit) X Recipe amount in gm/l} / Stock solution%]
= [{(50 ml/1000 ml) X 2 g/l} / 1.0%]
= 10 ml

4. Required antipilling agent = [{ Total liquor (lit) X Recipe amount in gm/l} / Stock solution%]
= [{(50 ml/1000 ml) X 1.0 g/l} / 1.0%]
= 5 ml

5. Required amount of glauber salt = [{ Total liquor (lit) X Recipe amount in gm/l} / Stock solution%]
= [{(50 ml/1000 ml) X 40 g/l} / 20%]
= 10 ml

6. Required amount of soda ash = [{ Total liquor (lit) X Recipe amount in gm/l} / Stock solution%]
= [{(50 ml/1000 ml) X 10 g/l} / 20%]
= 2.5 ml

7. Required Dye solution = [{Material weight X recipe amount % (or shade %)} / Stock solution%]
= {(5.0 gm X 1.5%) / 1.0%}
= 7.5 ml

8. Required amount of additional water = {50 – (2.5 + 10+5+7.5+10+2.5)} ml
= (50 – 37.5) ml
= 12.5 ml

Calculation of the dyeing recipe is done by the dyeing master. The whole work process is done in lap dip. Lab dip is a process by which buyers supplied swatch is matched with the percentage of the varying dye in the laboratory. Lab dip plays an important role in shade matching & and detaching the characteristics of the dyes and chemicals that are to be used in the large scale of production. So this is an important task before bulk production.

Chapter-05

Printing

What is Print?

Printing is another part of wet processing technology. Printing is carried out after pre-treatment of fabric or after dyeing of the fabric. Printing is carried out for producing attractive designs on fabric or other materials. The printing is described as localized dying I .e, dyes or pigments are applied locally or discontinuously to produce the various attractive design on fabric.

Common Styles of Textile Printing

Direct Printing: In direct printing, a color pattern is printed directly from a dye or pigment paste onto a textile substrate without any prior mordanting step or a follow-up step of dyeing, etc.

Transform printing : In transfer printing, a design is printed first on a flexible non-textile substrate (e. g. paper) and later transferred from the paper to a textile substrate.

Discharge Printing: In discharge printing, chemicals are applied, which locally destroy the dyestuff. Textile fabric is first dyed with a suitable dye n discharge printing, and then the dye is selectively destroyed from certain areas of the fabric to give the look of a printed pattern.

Resist Printing: In resist printing, a paste or material is printed on the fabric which prevents access of the dye to the fibers. On dyeing, the fabric attains color only on areas where resist agent is not present. After dyeing, the resist agent is removed and the fabric gives the look of a printed pattern.

Common Methods of Textile Printing

Block Printing: The block printing is an old method of printing which involves the use of wooden blocks with raised printing surface, which are inked and then pressed on to the fabric. The transferred dye was then fixed on the fabric through appropriate methods. This printing method is used only at small scale or in cottage industry and is not used at industrial scale because of less flexibility and productivity.

Screen Printing: The screen printing is the most commonly used printing method at industrial scale. There are two main types of screen printing: flat-bed screen printing and rotary screen printing. Flat-bed screen printing can be manual or automatic. Rotary

screen printing is usually automatic and gives the highest printing productivity. Screen printing involves passing the print paste onto a fabric through a mesh or screen which has some open and some blocked areas according to the desired print pattern. The print design obtained on the fabric depends on the pattern of the open areas of the screen.

Roller Printing: The roller printing is done by making use of heavy copper rollers engraved with a pattern. A separate roller is used for printing each colour in the pattern. Due to low productivity, roller printing method has been almost completely replaced by rotary scree
n printing.

Digital Printing: Digital ink-jet printing is one of the most modern ways of printing textile fabrics. This method can be used for most of the commercially available fabrics. In this method, a printing pattern can be directly printed from the computer onto the fabric with an ink-jet printer, without any need for making printing screens or engraved rollers. The design-to-print lead time is minimum in digital ink-jet printing and complex designs of photographic quality can be promptly printed. However, as compared to rotary screen printing, the productivity of ink-jet printing is very low. Hence, the method is mostly used for very short production runs or for printing smaller articles such as flags,

All Over Printing: All over printing is a special type of printing technology that allows a particular design to be repeated continuously throughout the entire surface of fabric or apparel. Any fabric can be printed by all over printing method (AOP). Rotary, flatbed screen machine, digital printing machine are used in all over print.

Process Flow Chart of Textile Printing Section:

(A typical flow chart of printing in textile industry)

Artwork from merchandiser
↓
Design input
↓
Design development
↓
Positive/film
↓

Requisition by merchandiser
↓
Panel (**cutting fabric** parts)
↓
Expose (frame adjusted)
↓
Fila and frame adjusted
↓
Water spray
↓
Panel send to buyer
↓
Buyer approval

↓
Counter sample
↓
P P production
↓
Accessories booking
↓
Requisition by merchandiser for fabric
↓
Fabric received and store
↓
Count the fabric
↓
Inspection the fabric
↓
Fabric adjusted
↓
Bulk production start
↓
Hydro extractor from dryer
↓
Inspection
↓
Finishing
↓
Delivery

Preparation of cloth for printing

Cloth is prepared by washing and bleaching. For a coloured ground it is then dyed. The cloth has always to be brushed, to free it from loose nap, flocks and dust that it picks up whilst stored. Frequently, too, it has to be sheared by being passed over rapidly revolving knives arranged spirally round an axle, which rapidly and effectually cuts off all filaments and knots, leaving the cloth perfectly smooth and clean and in a condition fit to receive impressions of the most delicate engraving. Some fabrics require very careful stretching and straightening on a stender before they are wound around hollow wooden or iron centers into rolls of convenient size for mounting on the printing machines.

Preparation of colours:

The art of making colours for textile printing demands both chemical knowledge and extensive technical experience, for their ingredients must not only be in proper proportion to each other, but also specially chosen and compounded for the particular style of work in hand. A colour must comply to conditions such as shade, quality and fastness; where more colours are associated in the same design each must be capable of withstanding the various operations necessary for the development and fixation of the others. All printing pastes whether containing colouring matter or not are known technically as colours.

Methods of printing

There are eight distinct methods presently used to impress coloured patterns on cloth:

- Hand block printing
- Perrotine printing
- Engraved copperplate printing
- Roller, cylinder, or machine printing
- Stencil printing
- Screen printing
- Digital textile printing
- Flexo textile printing
- Discharge Printing

Styles Of Printing:

- There are three different styles of printing. Such as:
- (a) Direct style of printing
- (b) Discharge style of printing (White discharge &Color discharge)
-
- Resist style of printing. (White resist & Color resist)

Basic color for printing :

- Beza print black DW
- Beza print Red KGC
- Beza print Green BT
- Beza print Turkish GT
- Beza print Blue BT
- Beza print Violet KB
- Beza print Violet FB
- Beza print Yellow FB
- Beza print Yellow RR
- Beza print Yellow BGT

Note: If body color is white there is no white coating is not used. But for other color a white coating is used before printing.

Chapter-06

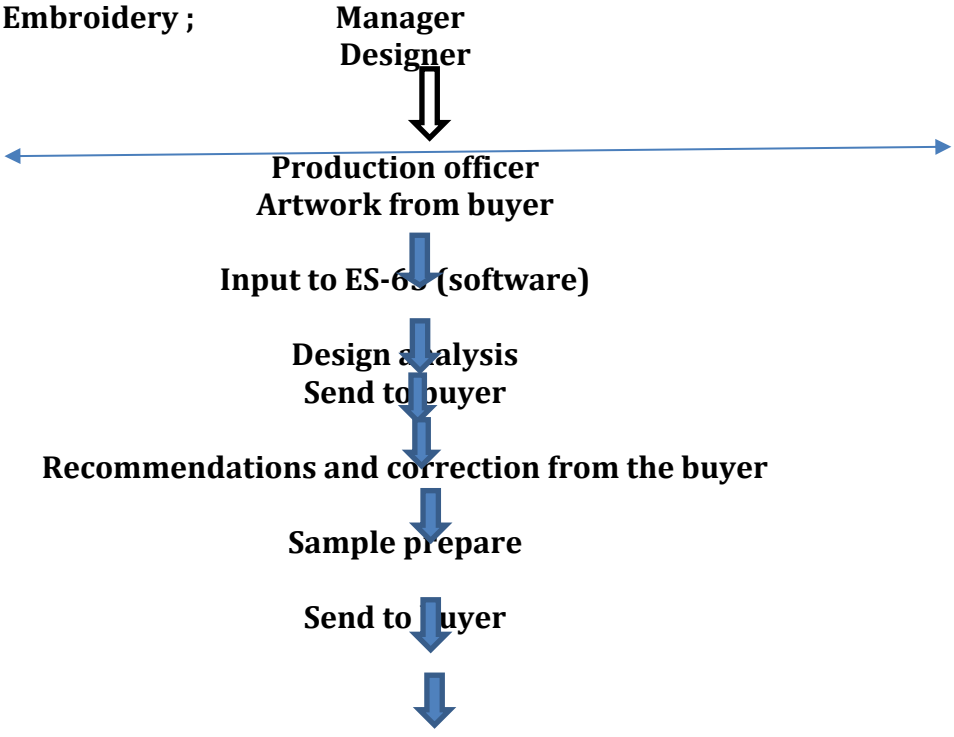
Embroidery

Embroidery :

Embroidery is the method used for decorating fabrics with a needle and a thread. Embroidery styles and techniques vary greatly but in this tutorial, DMC will be featuring free style or "surface embroidery." This decorative stitching technique, with its varied stitches, is worked independently from the fabric's weave allowing you to embroider any design, realistic or abstract, onto any fabric you choose. Surface Embroidery offers you the greatest versatility to create beautiful designs using DMC's colorful threads and specialty fibers.

Organogram of Embroidery:

Flow chart of Embroidery ;



Bulk production

Different types of Embroidery :

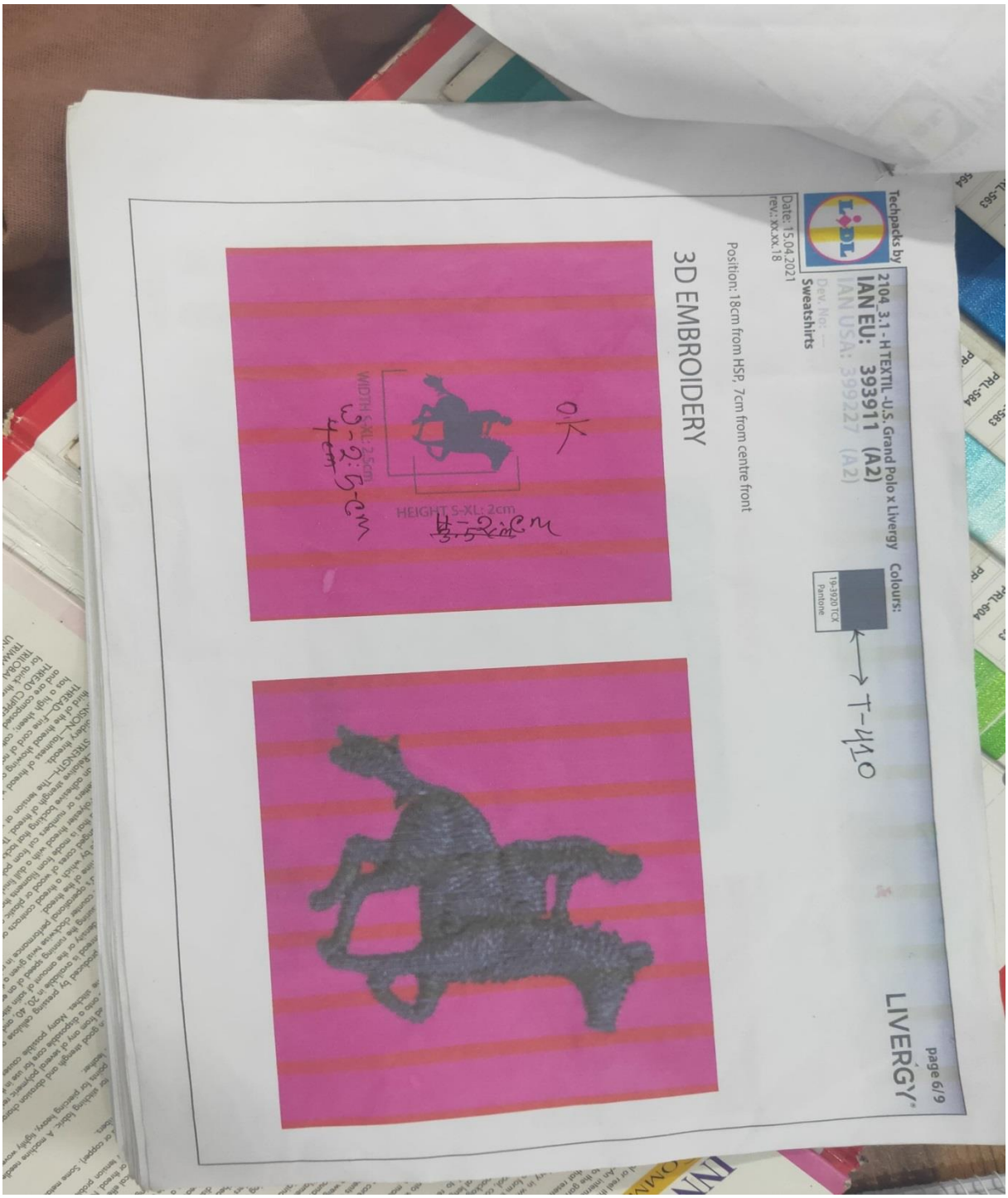
1. Colors reversible sequins
2. Flat embroidery
3. Chenille embroidery
4. Metallic embroidery
5. Applic embroidery
6. Chain stitch embroidery
7. Cording embroidery
8. 3D embroidery
9. Chenille coil stitch embroidery
10. Metallic chain stitch embroidery
11. Tatami stitch

Embroidery faults:

1.Stitch gap
2.Bobbin out
3.Oil spot
4.Miss thread
5.Measurement
6.Up-down
7.Needle Hole

Chapter -07

Cutting



Introduction :

The cutting department is responsible for cutting fabrics and feeding the sewing department with cuttings. The cutting department's capacity is planned based on the daily feeding requirement of the sewing lines. The cutting department is set up with a cutting department head, cutters, spreaders, quality checkers and helpers for sorting, ply numbering and bundling. The activities of the cutting department are explained in this post.

Flow chart of cutting :

Production order sheet =>
Pattern receive =>
Marker making =
> Fabric receive =>
Fabric spreading =>
Marker placing =
> Cutting =
> Sorting =
> Numbering and checking =
> Bundling
=> Input to sewing.

Cutting Machine :

Different Parts of Straight Knife Cutting Machine

A straight knife machine has the following main parts (See the Figure-3):

1. Upper handle,
2. Electrical cable,
3. Motor,
4. Side handle,
5. Knife sharpener,
6. Stand,

7. Presser foot,
8. Straight knife, and
9. Base plate with rollers

Straight Knife Cutting machine:

Straight knife cutting machine is used to cut components of differing size. This is the most frequently used equipment for cutting garments in bulk. It is moved along the cut contours, while the fabric spread remains in a fixed position. The machines are manoeuvrable and capable of curvilinear cutting. Straight-knife cutting machine is the world's most popular and most versatile. Available in all standard electrical configurations, with the largest variety of sizes and blade speeds in the industry. It is the most useful cutting instrument in garments cutting. In apparel industry, more than 99% cases this knife is used.

This machine is called straight knife cutting machine because its cutter is straight in shape. It is used for both woven and knit fabric. In this machine different types of straight knife are used according to the different cutting objects. This machine provides good efficiency. The maximum height of a cut spread is 300 mm. The weight of the machines varies between 5 and 20 kg. Heavier machines are less manoeuvrable. Small-capacity production units may use only straight-knife machines. It is widely used in Bangladesh garments industry.

Features of Straight Knife Cutting machine:

1. The main parts of this machine are straight knife, electric motor, handle, grinder, base plate, stand/ knife holder, lubricating unit, wheel etc.
2. Could be used to cut higher depth of fabric.
3. Knife height is 10 cm to 33 cm.
4. Knife stroke is 2.5 cm to 4.5 cm.
5. Motor r.p.m. is 3000 to 4000.
6. Auto grinder is used
7. Auto lubricating unit works for this machine.
8. Different types of knife edge are used for cutting different objects. Such as, straight edge, wave edge, sew edge and serrated edge.
9. A Handle for the cutter to direct the Knife.
10. Knife guard is attached to the front of the knife.
11. Sharp and heavy corners can be cut.
12. Maximum 70% of knife height is used for fabric lay.
13. Wheels are under the base plate to move the machine smoothly.
14. Machine weight is around 12-15 kg.
15. Knife cut the fabric very fast due to high speed of motor. That increases the risk of fabric damage.
16. Suitable for mass trimming cotton, woolen, linen leather and chemical fiber goods, etc.
17. Neat cutting, small-curvature radius curvilinear cutting.
18. Low noise, stable running, easy to operate and high efficiency.
19. Incorporated with an auto knife-grinding device, easier to operate

Structure of Straight Knife Cutting Machine:

The straight knife cutting machine consists of a base plate, an upright stand to hold the vertical blade, motor, a handle for moving assembly,

a sharpening device and a handle to transfer the whole assembly from one place to another.Two kinds of power are required to operate a straight knife. Motor power drives the reciprocating blade and operator power drives the knife through the lay. Normally the available blade heights vary from 10 cm to 33 cm and normally available strokes vary from 2.5 to 4.5 cm. The greater the blade movement the faster the blade cuts the fabric and more easily the operator can move the machine.
The most important consideration is selecting a straight knife is the power required from the operator to move the knife is the power required for the operator to move the knife through the lay. Operator effort is affected by the weight of the motor, the shape of the stand, handle height, stroke, sharpness of blade and the base plate movement.

Parts of Quality Control Cutting Section

Quality control of the cutting section mainly divided into four parts. Those are:

1. Marker Inspection
2. Spreading Control
3. Cutting Quality control
4. Piece Goods Inspection

Marker Inspection following things are inspected

1. Marker Length
2. Marker width
3. Lay quantity
4. Style/Lot
5. Ratio
6. The measure of all individual parts marked in marker

Following work in Spreading Quality control

1. Cut numbers
2. Ends
3. Leaning
4. Tension
5. Narrow Goods
6. Remnants
7. Counts
8. Ply Height
9. Fabric Fault

Cutting Quality Control

1. Number of parts
2. Miss cut
3. Ragged cutting
4. Notches
5. Matching plies

Piece Goods Inspection

1. Quantity
2. End out
3. Knot
4. Spot
5. Hole
6. Thick yarn
7. Missing yarn
8. Shading
9. Slab

Methods of Fabric Cutting:

Fabric cutting methods are as follows:

- **Manual Method:**

1. Scissor.
2. Straight knife.
3. Band knife.
4. Round knife.
5. Die cutting
6. Notches
7. Drill etc..

Computerized Method:

1. Straight knife cutting (GERBER Cutter).
2. Water jet cutting.
3. Laser beam cutting.
4. Plasma torch cutting

Mainly three methods of manual cutting are used in factory:

1. Auto cutter machine (GERBER Cutter).

2. Straight knife.

3. Scissor

Numbering:

In this stage sticker is attached with all part of cutting part for shade matching. The sticker number maintains cutting number, size number, serial number

Bundling

Prepare bundling card according to fabric lay report this card maintains

1:Date.

2:Style No.

3:Size Number.

4:Quantity.

5:Color.

6: Lot Number

Quality Check (Panel check)

1:Oil spot

2:Dirty spot

3:Crease mark

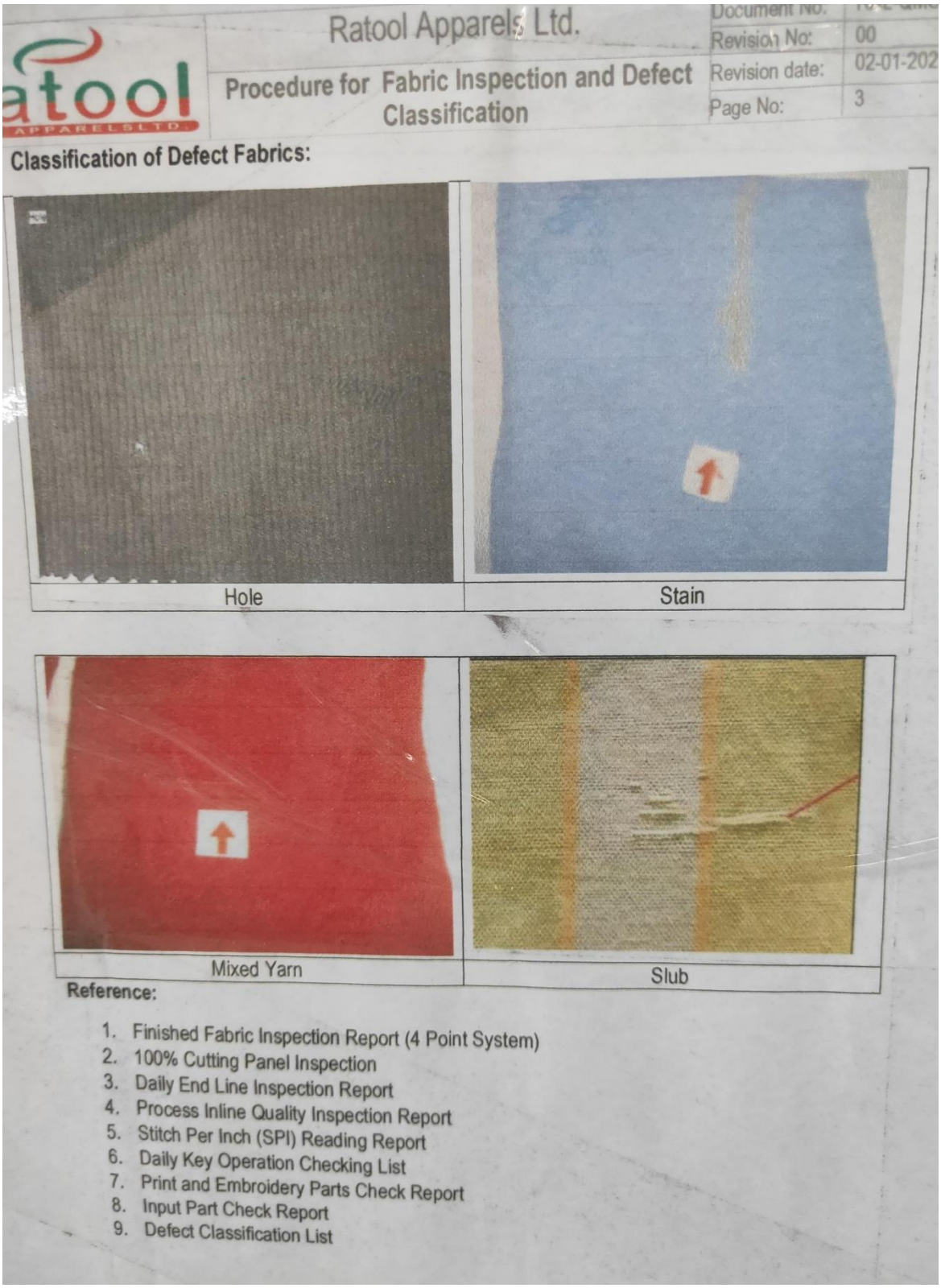
4:Needle mark

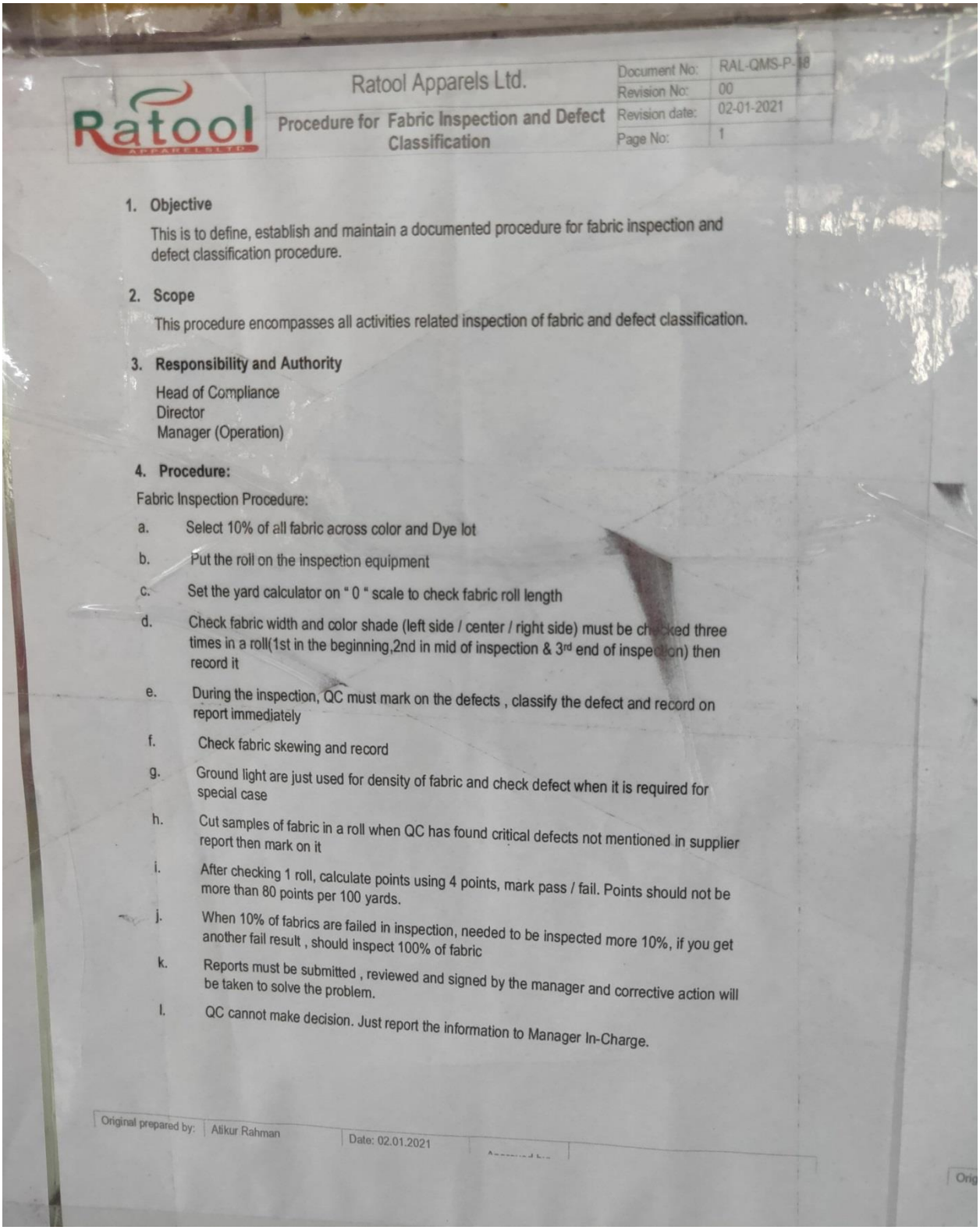
5:Foreign yarn

6:Slub

7:Contamination Hole

Picture of quality check :





Ratool

Ratool Apparels Ltd.

Procedure for Fabric Inspection and Defect Classification

Document No:	RAL-QMS-P-18
Revision No:	00
Revision date:	02-01-2021
Page No:	1

1. **Objective**

   This is to define, establish and maintain a documented procedure for fabric inspection and defect classification procedure.

2. **Scope**

   This procedure encompasses all activities related inspection of fabric and defect classification.

3. **Responsibility and Authority**

   Head of Compliance
   Director
   Manager (Operation)

4. **Procedure:**

Fabric Inspection Procedure:

a. Select 10% of all fabric across color and Dye lot

b. Put the roll on the inspection equipment

c. Set the yard calculator on " 0 " scale to check fabric roll length

d. Check fabric width and color shade (left side / center / right side) must be checked three times in a roll(1st in the beginning,2nd in mid of inspection & 3rd end of inspection) then record it

e. During the inspection, QC must mark on the defects , classify the defect and record on report immediately

f. Check fabric skewing and record

g. Ground light are just used for density of fabric and check defect when it is required for special case

h. Cut samples of fabric in a roll when QC has found critical defects not mentioned in supplier report then mark on it

i. After checking 1 roll, calculate points using 4 points, mark pass / fail. Points should not be more than 80 points per 100 yards.

j. When 10% of fabrics are failed in inspection, needed to be inspected more 10%, if you get another fail result , should inspect 100% of fabric

k. Reports must be submitted , reviewed and signed by the manager and corrective action will be taken to solve the problem.

l. QC cannot make decision. Just report the information to Manager In-Charge.

Original prepared by:	Atikur Rahman	Date: 02.01.2021	

Chapter-08

Sewing, quality and finishing :

Sewing section:

Sewing is a craft that involves stitching fabrics together either with a needle and thread by hand or with a machine. Although it's a needle craft, it differs from knitting, crocheting, needlepoint, cross stitch, embroidery, and the like because it's not decorative, but rather constructive. There are many industrial sewing applications like making ready to wear clothes, leather clothes, shoes, etc. There are many types of stitches a few as below Over lock, Pad Stitch, Chain Stitch, Cross Stitch, back stitch.

Plain Sewing:

This is done to fulfill the functional needs like making or mending clothing. This can also be for household linens and garment manufacturing. Fancy sewing: This is usually decorative sewing which includes techniques such as smocking, embroidery, shirring, quilting, etc.

Process Flow Chart for Garments Sewing Department:

Product analysis
↓
Set up a target for production
↓
Set up machine layout based on target
↓
Set up operator layout based on target
↓
QC check of the product
↓
Line balancing
↓
Line setup
↓
Distribution of all the processes
↓
Cutting parts received section
↓
Cutting parts distribution to the operator and helper
↓
Complete parts making individually
↓
Online QC check
↓
Online quality audit
↓
Counting output and checking with the target
↓
Final quality check (for each Garment)

Different Types of Sewing Machine

1. Single Needle Lock Stitch
2. Overlock
3. Compressor Flat Lock
4. Cylinder Bed Flat Lock
5. Flat Bed Flat Lock
6. Small Cylinder Bed Flat Lock
7. Mini Cylinder Bed Flat Lock
8. Feed of the Arm
9. Bartack
10. Button Hole
11. Button Attach
12. Piping Cutter
13. LZ
14. Flat Seamer
15. Automatic Hot Press

Working way of sewing floor:

Product Analysis and set up target for Line: Here usually find the critical operation of the product by analyzing the product and decide where need help, which operator works on which operation. After analyzing the product line target is set for per hour production. Line supervisor monitoring target production achieving or not.

Set up machine layout on the basis of Target: On the basis of operation layout and target of per line, machine layout is setup to ensuring target per hour production.

Line balancing: Line balancing is a tool used for production line to capacitate the flow line of production. If line is not balanced properly, required target result will not be achieved properly. Some work have higher work load, some have lower load which caused bottleneck in the line.

Bundle Input to Line: After ensuring line balancing, bundle wise cut panel input to line as per pre-determined manner to workers.

5.5.5:Sewing: Workers sew different parts as per pre-determined manner according to machine layout for ensuring right operation is made by right machine and right operator.

Online Quality check: In this stage, front and back part sewing quality checked by on-line quality inspector. If found any defect, send the garment to that operator who sew the defective for repair the sewing faults.

End line Quality check: Here Full garments of both inside and outside checked properly to ensure the garments is defect free. If found any defect, repair that defect by who are responsible for that defect. Here also count the body to comparing if target is achieved or not.

Body sends to finishing section: After end line quality inspector, garments are sending to finishing section for finished the body for shipment as per buyer's requirements.

Elements of sewing section:

1. Sewing thread
2. Needle
3. Sewing Machine

Sewing defects:

1. Needle damage
2. Skip stitches
3. Thread breakages
4. Broken stitches
5. Seam puckering
6. Pleated seam
7. Wrong stitch density
8. Uneven stitch density
9. Staggered stitch
10. Improperly formed stitches

For making a basic shirt, we need 7 types of sewing machines. They are given below:

1. Plain Machine or Lock Stitch Machine
2. Over lock or over edge Stitch Machine
3. Button Holing Machine
4. Button Attaching Machine
5. Feed of the Arm
6. Kansai or Multi needle chain stitch machine
7. Single Needle & Double Needle Chain Stitch Machine (with or without edge cutter & thread cutting mechanism)

Important sewing machine descriptions are given below:

Plain Machine or Lock Stitch Machine:

- No. of needle: Generally 1 needle or 2 needles
- SPM (Stitches per Minute): 1500-5500
- Stitch Length: 5mm in Juki
- Automatic Thread Cutting
- Automatic Bobbin Winging
- Edge Cutting System
- Most commonly used for sewing of woven garments.

Over lock or Over edge Stitch machine:

- No. of needle: one or 2 needle
- No. of thread: 2-5 threads
- SPM: 6500-8000
- Stitch length: maximum 4mm and stitch length can be changed by push button.

Button Holing Machine:

- Stitch group: lock or chain stitch
- Arrangement of button hole size being small or larger
- Arrangement of stitch density being increased or reduced.
- Button hole can be made to cut the hole before or after sewing a button hole.

Chain Stitch Machine:

- No. of needle: one or more needle
- No. of thread: one or more thread (Single thread or multi thread)
- SPM: 1800-6000
- Stitch length : 1.4 to 4.5 mm
- Automatic thread trimmer
- Various types of feed mechanism is adjusted to the machine.
- Used in knitted wear and jeans

SMV related formula:

Observed rating

a) Rating = × 100% Standard rating .

b) Standard Rating: The pace at which a qualified worker performs a task. (Standard Rating=100).

c) S M V = Basic time + Allowances

d) Basic time= Observed time × Rating

i. 60

e) Individual Target = ----------

i. SMV

b. 60

f) Line Target = ---------- × manpower

a. SMV

b. Produce Minute

g) Efficiency = ----------

1. Used Minute

h) Produced minutes = Produced quantity × SMV

i) Used minutes = Manpower × Working hours

Sewing Line Quality Check List:

1. Buyer Approved Sample & Measurement Sheet Check.
2. Sample Wise Input Check.
3. Buyer Approved Trims Card Check.
4. Buyer Approved Sample Wise Style Check.
5. All Machine Thread Tension Check.

6. Style Wise Print & Embroidery Placement Check.

7. All Process Measurement Check.

8. All Machine Oil Spot Check.

9. All Process S.P.I Check as Per Buyer Requirement.

10. Input Time Shading, Bundle Mistake & Size Mistake Check.

11. Buyer Approved Wise Contrast Color Check.

12. As per Buyer Requirement Wise Styling Check.

13. All Machine Stitch Tension Balance Properly.

Sewing Quality checking points:

a) Skip/Drop/Broken stitch

b) Raw edge

c) Size mistake

d) Uneven hem

e) Uneven cuff

f) Uneven neck

g) Uneven shoulder

h) Uneven placket

i) Uneven pocket

j) Twisting Without care label

k) Open tack

l) Sleeve up-down

m) Stripe up- down

Garments finishing Section :

Garments finishing is an important section in the **readymade garments sector**. It's the last section of the **garments manufacturing** department. As with all the other sections of garments manufacturing, the garments finishing section has also followed a process flow chart, which has explained in this article.

Process Flow Chart of Garments Finishing:

Sewn garments received in finishing section
↓
Initial quality **check**
↓
Spot removing if there's any spot
↓
Ironing or pressing
↓
Inspection
↓
Hangtag attaching
↓
Folding
↓
Polybag
↓
Metal check
↓
Packaging or **cortoning**

Objectives of Garments Finishing:

* To enhance the suitability of the fabric for end use.
* To improve appearance and sale appeal for comport and utility desirable qualities to the fabric like-
a. Softness
b. Luster
c. Drape
d. Dimensional
e. Stability
f. Crease recovery
g. Soil repellence

5.15:List of Accessories Used in Finishing Section:

I. Main Level
II. Size Level
III. Care Level
IV. Hang Tag

V. Bar code Sticker
VI. Poly Bag
VII. Tag Pin
VIII. Carton Hang
IX. Tag String
X. Clip Paper
XI. Gum
XII. Tape
XIII. Silica Gel

Chapter-09

Merchandiser

Introduction:

Merchandising means to promote and sell a product to the potential customer/buyer. The person, who do this job is called merchandiser. Since the sales process often starts with the eyes, merchandising typically involves presenting products in a visually favorable light, to try and encourage purchases.

But in textile sector merchandising is a process which starts from buyer developing to price submitting, order confirming and then execute the order to ship goods in time with quality is called garments/apparel merchandising. It is the garments whole selling business with foreign buyer or countries.

Need Of Merchandiser:
The position "Merchandiser" is playing a vital role in the RMG sector today. Merchandiser is the person who handles around 75% of the cost related to the garment & the production cost is only be almost about 25% of the garment. There by the role of Merchandiser in the apparel sector plays the most responsible part mainly for the financial benefit of the Company. The Merchandiser's small mistake will affect 75% of income of the order which will leads to a big disaster. This has to be understood by the Merchandisers seriously.

Responsibilities of a merchandiser:

A merchandiser do some specific work. These are;

1. **Fabric requirements calculations:** Merchandisers calculated total fabric consumption for a garment.
2. **Accessories requirements calculations:** They calculated how many types of accessories and quantity required for a garment.
3. **Sourcing of fabric:** They collected buyer required fabric from different countries and fabric manufacturer.
4. **Sourcing of accessories:** They collected buyer required accessories from recommended company.

5. **Costing and pricing:** The most important work of a merchandiser is costing and pricing. Here merchandiser negotiate a reasonable price with buyer including all types of cost to produce this garments and profit.
6. **Communication to buyers:** A merchandiser need to communicate with buyer from confirming the order to final shipment.

The Main Procedures Of Merchandisers Are As Followed:

I. Understanding sample order
II. Managing order route card and production timetable
III. Using route card to reschedule activities
IV. Submitting pre-production samples
V. Solving shortage problem
VI. Communicating with associated people and buyer
VII. Concluder remark on merchandising

Flow chart or Sequence of merchandising:

Receive order from Buyer
(Sketch or picture, measurement chart, material details)
↓
Consumption
↓
Costing
↓
Negotiation with Buyer
↓
Order receiving
↓
L/C receiving
↓
Back to back L/C opening
↓
Sample developing and Approving
↓
Approval for bulk production
↓
Related work to production planning
↓
Start bulk production
↓
Line inspection
↓
Final inspection by Buyer
↓
Shipment to Buyer

LIMITATIONS

- I have started industrial attachment from 1 Setember 2021, it has been finished after 30 November.
- Above few time for industrial attachment is not enough time to property complete industrial attachment. If I get more time I will know lot and complete it more effectively.
- The washing part is big here in the **RATOOL APPRELS LTD.** There are different types of machines in the washing department. But has limitation some area.
- Some operation are controlled of garments section by corporate office. Like Buyer co-ordination section, with CAD Marker & Pattern section & Merchandising.
- Not all operators can provide complete or accurate information because he works beyond the limits.
- It is not possible to reporting full information for some limitation. So, I try our best to summarize all the information.

The End