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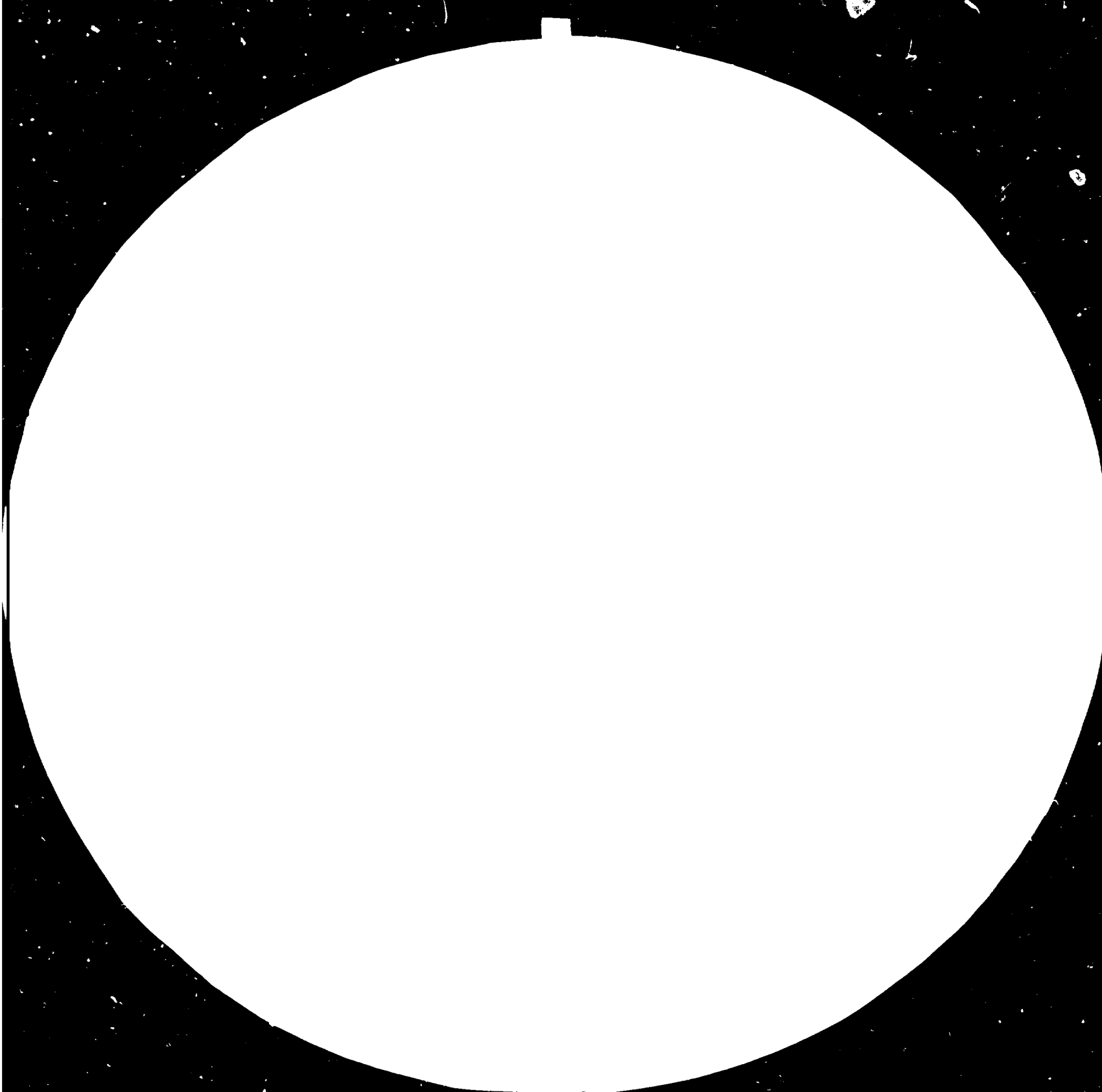

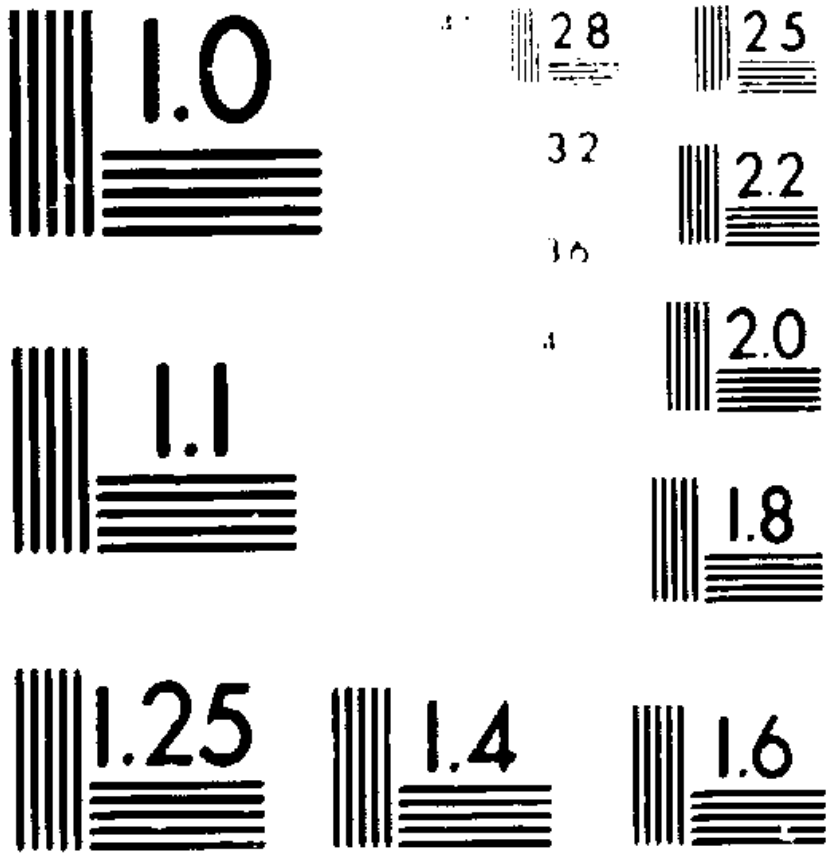

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DEVELOPMENT OF HOSIERY AND KNITWEAR INDUSTRY,
LUDHIANA, PUNJAB (PHASE II)

DP/IND/82/006

INDIA.

Technical Report: Technical assistance in the field of knitting*

Prepared for the Government of India
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Paul Kotesovec
Knitting Technologist

United Nations Industrial Development Organization
Vienna

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INTRODUCTION

This report gives an account of my activities carried out during my nine months' assignment as Knitting Technologist to assist the Knitwear Facility of the Punjab State Hosiery and Knitting Corporation in Ludhiana (see Annex I - Job Description). It is a further elaboration of my Progress Report submitted on 22 August 1983. The report also recommends a programme to optimize the utilization of the knitting capacity installed in the Facility and Part-II contains guidelines for producing woollen knitwear of high quality and with dimensional stability.

The counterpart staff, having already a sufficiently high technological level at my arrival was further trained in working independently on sophisticated mechanical V-bed and full fashioning machines. They are ready to receive the first level of electronic knitting machine - soon to arrive - and to train and advice technical staff of local knitwear manufacturers.

I assisted the most advanced knitwear enterprises in developing a knitwear collection, part of which was displayed at the 1984 Spring Fair in Paris (Prêt-á-porter). The Ludhiana knitwear industry, now experiencing a period of acceleration in technology is fortunate to have the Knitwear Facility with a competent knitting advisory staff at their disposal.

PART - I

Section A

TRAINING AND TECHNICAL GUIDANCE IMPARTED TO THE PERSONNEL OF THE KNITWEAR FACILITY

Extensive training and technical guidance was imparted to the personnel of different sections connected with development of knitwear garments including the knitting, making-up, pattern making, designing and finishing sections.

A. Knitting section:

In this section, the Knitting room manager, the operator of the fully fashioned (Cotton frame) and power flats and also operators of hand-flat knitting machines received training.

1. In respect of the fully fashioned knitting machine:

The Knitting room manager and the operator of the machine have been trained to:

- make correct stitch length setting in order to develop single bed structures of any given yarn (wool, wool-blends, acrylics, mercerized cotton, textured filament synthetics),
- make use of different borders and the correlation of the single bed knits, 1 x 1 rib borders, 1 x 1 doubled rib borders, tubular welts, fancy borders,
- make correct dimensional calculations (number of needles, courses, widening, narrowing etc.) for the classic style ladies and gents garments based on the paper patterns such as:
  a) raglan sleeves,
  b) French sleeves,
  c) Saddle sleeves
  d) general sleeves
- Make exact calculations for accurate positioning of the garment components like the neck outlines, pocketsand isolated designs.

General guidance have been given for maintenance and upkeep of the fully fashioned machines.

Records of all dimensional calculations are preserved in the Knitting room.

2. In respect of the power flats:

The Knitting room manager and also the machine operator have been trained in:

- correct stitch-length settings for any given yarn (wool, wool-blends, acrylics, cotton) for all structures,
- conducting trials for all possible designs such as:
  a) basic structures as on the handflats,
  b) colour jacquards in 2, 3 and 4 colours,
  c) colour jacquard backing (offside) in birdseye and striping,
  d) colour jacquards with transfer designs,
  e) single bed fancy stitch (knit-tuck-miss)
  f) double bed fancy stitch,
  g) purl stitch jacquard transfer,
  h) cables,
- setting up and making correct use of :
  a) presser foot operation,
  b) multi-garment attachment,
  c) positive feed device,
- undertaking:
  a) maintenance of the power flat,
  b) needle bed repairs and other minor repairs,
  c) change over of the needle bed from one machine gauge to another.
- Also, in order to make full use of the pattern possibilities, thorough training and instructions have been imparted in respect of:
  a) designing in all the above mentioned techniques,
  b) pattern graph making,
  c) setting up of jacquard steel cards,
  d) elaboration and punching of movement chains with multiple repeats,
  e) correlation between the different parts and panels of the knitted garments (borders, welts etc.)

The knitting room manager and the machine operator has also been trained to make the dimensional calculations for any given fully fashioned garments on handflat machine (gauges 4, 6, 8, 10 and 12) as this skill will enable them, later on, to make full use of fashioning capability of the electronic power flats.

Comments:

To be able to make full and proper use of electronic power flats the operator must be conversant with the following :

a) entire capability of the hand flat knitting system. In this respect whatever shortcomings have been noticed with the knitting room manager and the operator they have been guided suitably.

b) the capability of the mechanical power flats.

The before-mentioned instructions given to the knitting room manager and the operator will enable them to knit all patterns and designs which the mechanical powerflats can make. These design ideas can originate from the professional designers or by copying from existing garments or from photographs and sketches. But they will also be able to develop their own design ideas beginning with yarn to the finished garments.

3. In respect of the hand-flat knitting machines:

At the initial stage of my assignment, the hand flat operators and the knitting room manager (who joined later) were trained in the correct elaboration of the basic knit structures taking into account the interaction of yarn, machine gauge and cam setting. This enables them to find out by trials the best possible result which can be achieved to make dimensionally stable and high quality knitwear.

The operators were also trained in evaluating the possible cam-settings of the same knit structures with respect to the different parameters, ie., extensibility, stitch definition, elasticity and their suitability to given kind of garments.

After this basic training, the knitting machine operators and the knitting room manager - when necessary - were trained in more elaborate patterns and designs/techniques.

a) With Ludhiana type flat knitting machines one can make:

- fancy structures
- open work designs
- transfer designs on single and double needle beds,
- cables, bi-colour cables, turnover cables,
- collars, bands and tapes,
- built-in pockets,

- single, double and fancy pipings for linking,
- knitted buttonholes,
- linking on the knitting machines.

b) With jacquard hand-flat knitting machines :

- two, and three colour jacquards with striped or birds-eye backing,
- fancy stitch jacquard single bed,
- fancy stitch jacquard double bed.

Instructions were also given on the design of jacquard patterns, making of the steel jacquard cards, setting up of the machine to make the structures.

B. Pattern making and cutting section:

The pattern maker in the Knitwear Facility is also responsible for making-up operations.

At the beginning of my assignment, I found that the knitting industry and also the Knitwear Facility personnel were not using paper patterns at all for cutting. Cutting of the garment blanks were done only on the basis of personal judgement of the cutting master on the spot - resulting in non-standardised and ill fitting garments.

On my recommendation, a pattern maker, educated at the Institute of Garment Technology at Amritsar, was appointed. Since the pattern maker was so far trained for making woven garments only, he was then trained by me in the basic requirements of manufacturing the cut and sew styles.

He has been given further training in more sophisticated styles particularly in the size-grading of fully fashioned knitwear.

The paper patterns developed subsequently in the Knitwear Facility are now being used widely in the knitting industry.

The advanced training given to the pattern maker includes:

- styles such as French, Saddle, Raglan and general sleeve garments,
- styles with box sleeve, Dolman sleeves and also Ponchoos,
- correct collar designs like high-neck, folded high-neck, boat-neck turtle neck, round-neck and V-neck.,

- construction and joining the different garment components by different making up techniques as linking, cup-seaming, flat-lock stitching, double linking, overlock and cover-seaming, chainstitching, 3 needle flat-lock seaming and so on.

C. Making-up Section:

The training areas covered for the operators are:

a) setting-up of the stitch length, overfeed, regulation of thread tensions and also the correct operational methods,
b) best making-up techniques with each of these machines,
c) setting of the components of a garment like the collars, sleeves, backs, tapes, pockets etc.,
d) correct use of different accessoires such as the buttons, zips etc. so as to give a consistent appearance to the garments.

D. Designing section:

Before they went to the New York Fashion Institute of Technology on UN fellowships, the two designers were instructed in the fundamentals of knitting and later on in fancy and jacquard designs as well, preparation of pattern graphs and appreciation of knitwear designing concept.

E. Finishing:

I found the project's Finishing Master competent and very well acquainted with modern knitwear finishing technology. Only marginal orientation and appreciation of the characteristics of knitstructures was sufficient for him. However, the concerned personnel were trained to appreciate the role of finishing procedures and suitable changes in knitting techniques to suit the finishing requirements.

During these trials more than 90 samples were made which were displayed in the Garments fair held in Delhi in August, 1983 and which will be shown in the Garment fairs to be held in Delhi and also in the Pret-a-porter Feminin during February, 1984.

PART - I

Section B

TRAINING IMPARTED TO THE PERSONNEL FROM OTHER INSTITUTIONS AND ENTERPRISES WHO CAME TO KNITWEAR FACILITY FOR THE PURPOSE DURING MY TENURE:

A. Training to the personnel from institutions:

1. Three batches of graduates of the Government Institute of Technology, Ludhiana were given advanced training in knitwear manufacturing. These batches were trained during:

   1st batch - from 1st to 7th December, 1983
   2nd batch - from 8th to 13th December, 1983
   3rd batch - from 23rd to 30th of December, 1983.

2. Two batches of officers of the Indian Petrochemical Corporation Limited, Baroda were trained in fundamental knitting technique during:
   1st batch - from 5th to 10th September, 1983
   2nd batch - from 2nd to 7th February, 1984.

B. Training to the personnel from enterprises:

1. The knitting master of M/s Saab Knitters, Ludhiana was given training in advanced knitting techniques - particularly in making sophisticated transfer designs.
   The duration of training was from 1st to 14th of July, 1983.

2. The Knitting master, Assistant knitting master and the power-flat machine operator of M/s York Hosiery Mills (P) Ltd Ludhiana were given advanced training in knitwear production technology during 2nd Juneto 30th June, 1983.

3. The knitting master of M/s. Swadeshi Karyalaya, Ludhiana was given training on basic pattern calculations and sampling during 2nd to 4th August, 1983.

PART - I

Section C

TRAINING AND TECHNICAL ASSISTANCE RENDERED TO THE VARIOUS UNITS OF KNITTING INDUSTRY OF LUDHIANA.

A preliminary survey of the industry was carried out by me at the beginning of my assignment to assess the training and technical assitance needs of the kntting industry.

In view of the general findings and also specific requests for assistance from the industrial units - particularly those interested in exporting their products - assistance programme was conceived and implemented accordingly. Since the industry was of the opinion that the assistance should be of immediate practical value and not only an academic exercise, the potential commercial benefits was kept in mind while helping them in designing,styling and production programming and in other related areas.

A garment fair was to be held in Delhi during August, 1985 in which several units of Ludhiana wanted to participate and display their knitwear collection to the buyers coming fromä USA, Canada, Western Europe,Japan and Australia. Most of the technical assistance visits to the industry are therefore concentrated around this time - preceeding this Fair.

I found that non availability of different types of yarn in good quality was a major impediment in the preparation of high quality knitwear. I therefore worked in collaboration with a spinning company - M/s. Kohinor spinning mills to develop yarns, particularly the local version of Shetland yarn for use by the knitting industry.

A knitting machine manufacturer - M/s. Paul Engineers, Ludhiana- was interested in developing a machine which could be of use to the knitting industry. I rendered designing and technical assistance in building a prototype model of a intersia hand flat knitting machine with M/s. Paul engineers so that they may later on mass produce the machine and make the machine available to the knitting industry.

The details of the actual assistance rendered to each unit is described in separate sheets following this note.

List of companies to whom technical assistance and guidance has been rendered by me for the purpose of which I visited their factories, often accompanied with the project personnel of the Knitwear Facility.

1. M/s. Swadeshi Karyalaya
2. M/s. Nagesh Knitwears
3. M/s. York Hosiery Mills (P) Ltd.,
4. M/s. Modella Knitwears Limited,
5. M/s. Saab Knitters
6. M/s. Sind Knitwears (P) Ltd.,
7. M/s. Vardhman spinning and weaving Mills Ltd.,
8. M/s. Ludhiana Wool Syndicate
9. M/s. Raja Hosiery Mills
10. M/s. Ess Ess Sales Corporation,
11. M/s. Tee-nit International
12. M/s. Deesons
13. M/s. Rosy Knitwear
14. M/s. Hind Hosiery and Woollen Mills
15. M/s. Oswal Woollen Mills Limited
16. M/s. Rai Bahadur Knitting works
17. M/s. Kohinoor Spinning Mills
18. M/s. Paul Engineers.

COMPANY BACKGROUND:

Name and address	:	M/s. Swadeshi Karyalaya, Daressi Ground, Ludhiana.
Name of contact executive	:	Mr. Virender Khosla
Type of operation	:	Manufacture of pullovers and cardigans for domestic market, manufacture of army software including jersey, beret caps, etc. Uses handflats and circular knitting machines.
DATE OF VISIT/S	:	April 1983 - 18, 22, 25 and 30 May, 1983 - 4 and 6 July, 1983 - 7, 11, 19 and 25 Aug, 1983 - 2 October 1983- 10
ASSISTANCE PROGRAMME:		Assisted in making a small collection of 8 samples to be carried by Mr. Khosla to USA for export promotion. Scope of assistance provided includes: - identification of styles to produce - selection of machine gauge and setting-up of the machine parameters - selection of yarn and colours - selection of accessories and trimmings, - use of patterns - knitting structures, - making-up of garments, - finishing, - guidance in acquiring the right weight for the garments, - guidance in costing, - marketing advice about - selling time, retail seasons, distribution pattern etc. Assisted in making a collection of 18 samples for display in Delhi garment fair in respect of : - selection of yarn, colours, knit structures - developing the samples - production programming and costing.

COMPANY BACKGROUND:

Name and address : M/s. Nagesh Knitwears
Civil Lines and G.T. Road, Ludhiana.

Name of the contact executive : Mr. D. P. Mehra

Type of operation : Manufacture of pullovers and cardigans for export markets and also for domestic market of India. Uses fully fashioned, circular, power and hand flats to make very high quality knitwear including sportswear type garments.

DATE OF VISIT/S :

May, 1983 - 5
July, 1983 - 13 and 27
August, 1983 - 2, 3 and 6
September, 1983 - 14
February, 1984 - 2, 6, 10 & 12

ASSISTANCE PROGRAMME: Assisted in making a collection of 30 new samples for Delhi Garment fair. Assistance included :

- making designs in power flat,
- yarn selection of lambswool, alpaca, angora and blends,
- style selection for sportswear and classic style pullovers,
- assistance in choosing the right knit structure and weight range,
- assistance in knitting and making-up of the styles,
- assistance in pattern usage for correct shape and fitting of knitwear,
- guidance on making Icelandic and Aran designs.

Assisted subsequently in making summerwear with circular knitted fabrics. Scope of assistance covered :

- selection of suitable design for making T-shirts and other light weight knitwear,
- designing assistance for chosen garments,
- assistance in making designs in circular knitting machinery,
- assistance in making up.
- guidance and briefing about export market requirements.

COMPANY BACKGROUND:

Name and address	:	M/s. York Hosiery Mills (P) Ltd., Civil Lines, Ludhiana.
Name of the contact executive	:	Mr. Rakesh Kumar
Type of operations:	:	Manufacture and export of Woollen knitwear produced in handflats and to a very limited extent in power flats. Men's pullover and ladies cardigan in heavier weight category -but in better quality - is their speciality.
DATE OF VISITS	:	May, 1983 - 27 June, 1983 - 1, 13, 22 July, 1983 - 6, 15, 23 August, 1983 - 3 September, 1983-14 and 22
ASSISTANCE PROGRAMME	:	Assistance has been provided in their export efforts to hard currency areas. The assistance provided includes: - guidance in making different styles such as French, saddle, fancy sleeves etc. - guidance in making sportswear with lambswool and shetland, - guidance in use of power flat designing and steel card preparation, - guidance in special making-up techniques for linked selvedges, built-in pockets, knitted buttonholes, making different kind of collars etc. - guidance and help in finishing of knitwear, - advice on costing for export markets, - advice and guidance on European markets, Assistance has also been rendered in making a collection of 15 garments for Delhi garment Fair.

COMPANY BACKGROUND:

Name and address	:	M/s. Modella Knitwears Limited, Industrial Area, "A", Ludhiana.
Name of the contact executive	:	Mr. Satish kumar
Type of operation	:	Manufacture and sale of medium quality ladies cardigans, gents pullovers, childrens' garments in domestic Indian market. Uses mostly hand flats and operates three second-hand powerflats.
DATES OF VISIT	:	April, 1983 - 16 and 26 June, 1983 - 22 and 30 July, 1983 - 18 and 28 August, 1983 - 6
ASSISTANCE PROGRAMME	:	Assistance has been provided in upgrading their present manufacturing technique and also in making a collection of 15 new styles for the Delhi Garment Fair. Assistance provided includes: - guidance in selection of styles, colours yarn, weight range, knit structure and embroidery design, - assistance in making-up techniques - assistance in the usage of pattern, - advice on export markets, - assitance in export costing for the representative range of samples.

COMPANY BACKGROUND:

Name and address	:	M/s. Saab Knitters, Civil Lines, Ludhiana.
Name of the contact executive	:	Mr. Brij Mohan Gupta
Type of operation	:	Manufactures ladies cardigan only with 12 and 10 gauge handflats for the Indian domestic market. Workmanship is medium quality.
DATES OF VISIT	:	June, 1983 - 29 July, 1983 - 18 and 23 August, 1983 - 3 December, 1983- 3 and 6
ASSISTANCE PROGRAMME:	:	Assisted in improving their product range and knitting technique and making-up operations: - guided in making different shoulders such as French sleeve, saddle sleeve and general cut, - rendered design assistance to make lace-work designs to make ladies tops, - assisted in choosing the right knit structures and stitch lengths for the desired weight range, - Assistance has also been given in developing a small collection of 12 samples for the Delhi garment fair. Assistance provided includes: - guidance in selection styles, colours and weight range, - selection of embroidery type and colur scheme suitable for Europe, - knitting and making up of the garments, - advice on export costing, - advice on export markets, - advice on production programming.

COMPANY BACKGROUND:

Name and address	:	M/s. Sind Knitwears (P) Ltd., G. T. Road, Ludhiana.
Name of the contact executive	:	Mr. Suresh Choudhary
Type of operation	:	Manufacture and export of pullovers and cardigans in the medium to heavy weight variety. Operates with hand-flats and Raschel knitting machine.
Dates of visit	:	June, 1983 - 22 July, 1983 - 5, 20 and 27 August, 1983 - 4
Assistance programme	:	Assistance rendered includes: - usage of paper patterns for correct shape and fit of the garments - selection of right yarn, colours and weight structure, - design assistance for pullovers, hooded jackets, ladies tops and cardigans, - guidance on making up, - assistance in embroidery decoration, - extensive assistance in adapting their existing range of garments for the hard currency markets, - advice on export costing and export market characteristics.

COMPANY BACKGROUND:

Name and address	:	M/s. Vardhaman spinning and weaving mills Limited (knitwear export wing) Industrial area "A", Textile colony, Ludhiana.
Name of the contact executive	:	Mr. Sehgal and Miss Anju
Type of operation	:	A composite mill with separate knitwear export wing, manufactures and exports knitwear to several countries. Produces medium to high quality garments but mainly cotton knitwear.
Dates of visit	:	May, 1983 - 26 July, 1983 - 12, 13, 14, 25 August, 1983 - 6
Assistance programme	:	Assistance rendered includes : - adaptation of their present range of knitwear to suit the export markets, - selection of the right yarn count, - selection of right knit structures and weight range, - selection of styles for pullovers, T-shirts and ladies tops, - guidance in designing and making up of the chosen styles. - advice on export market requirements. - assistance in developing a collection 20 garments - summerwear for the Delhi garment show. - assisted in selection and development of a small collection for the US buyers.

COMPANY BACKGROUND:

Name and address	:	M/s. Ludhiana Wool Syndicate, G. T. Road (west),. Ludhiana.
Name of the contact executive	:	Mr. S. P. Kapoor and Mr. Girish Kapoor,
Type of operation	:	Manufacture and sale of pullovers and cardigans in the domestic Indian market. Also caters to the Indian army requirements. Production is carried on with fully fashioned (Cobton frame) knitting machine and also hand flats. Also has one power flat. Quality medium range.
Dates of visit	:	April, 1983 - 15 May, 1983 - 7 June, 1983 - 21 July, 1983 - 6,8,19, 27 August, 1983 - 6
Assistance programme	:	Assistance rendered includes: - guidance in the usage of paper pattern to achieve proper fit and shapeof the garments, - assistance in achiving the right weight range of the garments produced by them, - assistance in selection of yarn, colours, knit structures and design for making a collection of 22 garments for the Delhi garment fair, - advice on export market characteristics and overseas buyers' preferences.

COMPANY BACKGROUND:

Name and address	:	M/s. Raja Hosiery Mills, Deep Nagar, Civil Lines, Ludhiana.
Name of the contact executive	:	Mr. R. L. Khosla
Type of operation	:	Manufacture and sale in the Indian domestic market of pullovers for men and childrenwear of very high quality. Uses only handflats.
Dates of visit	:	Juene, 1983 -21 and 27 July, 1983 -13 and 30 August, 1983 - 3 February, 1984 - 17
Assistance programme	:	Assistance rendered includes: - adaptation of their present range of garments for the European markets, - assisted in selection of the designs, colours and knit structures, - uaage of the paper patterns, - adviced on export costing and export market characteristics. - helped in making a collection of 15 garments for the Delhi garment fair.

COMPANY BACKGROUND:

Name and address	:	M/s. Tee-nit International, Saraabha Nagar, Ludhiana.
Name of the contact executive	:	Mr. D. P. Puri and Mr. Rajan Puri
Type of operation	:	Manufacture and sale of fancy style pullovers, cardigans, skivies and tops in the Indian domestic market. Uses only hand flats but produces medium to high quality garments.
Date of visits	:	July, 1983 - 4 September, 1983 - 14 and 22 October, 1983 - 15 December, 1983 - 6
Assistance programme:	:	Assistance rendered includes: - guidance in knitting and finishing of lambswool and shetland garments, - guidance in knitting of pure silk yarn, - guidance on costing of export samples, - advice on export marketing and export market preferences of Europe.

company background :

Name and address	:	M/s. Ess Ess Sales Corporation, Industrial area, Ludhiana.
Name of the contact executive	:	Mr. Sanjeev Soni,
Type of operation	:	Manufactures and exports (mainly to the Middle east) knitwear for ladies and gents. Uses hand flats only and the quality range is medium.
Dates of visit	:	July, 1983 - 9, 18 and 28 August, 1983 - 1
Assistance programme:		Assistance given includes :

- adaptationof their current range of production by changing the yarn, weight and knit structures,
- guidance in the use of paper pattern to achive correct shape and fit of of the knitted garments,
- guidance in making -up of garments,
- guidance in developing a collection of 15 garments for the Delhi garment Fair.
- guidance in developing suitable knit structure in fancy (loop and slub) yarn,
- advice on costing and export market characteristics.

COMPANY BACKGROUND:

Name and address	:	M/s. Deesons, Bharatnagar Chowk, Ludhiana.
Name of the contact executive	:	Mr. Ajay Dewan.
Type of operation	:	Manufacture and sale of ladies cardigans, mens pullovers and T-shirts in the domestic Indian market in the medium to high range of quality.
Dates of visit	:	July, 1983 - 4 December, 1983 - 3 and 6
Assistance programme:	:	Assistance rendered includes: - guidance in making up of light weight summer-wear, - selection of samples export market, - guidance and advice on export costing and export marketing .

COMPANY BACKGROUND:

Name and address	:	M/s. Rosy Knitwear, 400 Mall Road, Ludhiana.
Contact executive	:	Mr. B. M. Kalra
Nature of operation	:	Manufacture and sale of childrenwear only in the domestic Indian market using acrylic, velour and fancy yarn. Uses hand-flats, purl knitting machinery and assorted making up machinery. Good quality.
Dates of visit	:	June, 1983 -6 July, 1983 - 27
Assistance programme	:	Assistance rendered includes: - selection of sample range for the Delhi garment fair, - advice on the export market and export marketing practice - advice on the possibility of producing ladies cardigan with fully fashioned knitting machines with lace attachment device

COMPANY BACKGROUND:

Name and address	:	M/s. Hind Hosiery and woollen Mills, Focal point, Dhandari kalan, Ludhiana.
Name of the contact executive	:	Mr. Nayyar (Bobboo)
Type of operation	:	Manufacture and export of woollen and cotton velour knitwear/garments. Uses handflats and circular knitting machinery. quality medium.
Dates of visit	:	May, 1983 - 31 June, 1983 - 20
Assistance programme	:	Assistance rendered includes: - guidance on proper operation of the modern circular knitting machinery, - advice on the export market requirements and adaptation of their current range of samples.

COMPANY BACKGROUND:

Name and address	:	M/s. Oswal Woollen Mills Limited, Unit Number 5, Industrial area-B, Ludhiana.
Name of the contact executive	:	Mr. Jhangilal Oswal and Mr. Bakhtawar Singh Mann,
Type of operation	:	Member of the largest knitwear export group of Ludhiana. Produces and exports pullovers and cardigans. Also sells a large quantiy of ladies cardigans in the domestic Indian market. Uses handflats, power-flats, circular and fully fashioned knitting machinery with complements of making up machinery.
Dates of visit	:	May, 1983 - 25 June, 1983 - 22
Assistance programme	:	Assistance rendered includes: - guidance on the selection of yarn, colour and designs for the export markets. - review of their existing range of samples and advice on future sampling activity.

COMPANY BACKGROUND:

Name and address	:	M/s. Rai Bahadur knitting works, Industrial area -A, Ludhiana.
Name of the contact executive	:	Mr. K. K. Adya
Type of operation	:	Manufactures and exports fashionable and classic garments- mainly ladieswear - to Western Europe and USA. Operates with fully fashioned and hand flat knitting machines.
Dates of visit	:	April, 1983 - 15 and 26
Assistance programme	:	Assistance rendered includes : - extensive review of their present range of production and advice on making future collection to suit export markets,

COMPANY BACKGROUND:

Name and address	:	M/s. Kohinoor Spinning mills, Industrial area -B, Ludhiana.
Name of the contact executive	:	Mr. Raj Behl and Mr. Rajneesh Behl
Type of operation	:	Spinning of woollen, worsted and acrylic yarn for sale to Ludhiana based knitters.
Dates of visit	:	May, 1983 - 26 June, 1983 - 16 July, 1983 - 8 and 22 August, 1983 - 2 October, 1983 - 15
Assistance rendered	:	Assistance rendered includes: - guidance in developing yarns for use of knitting industry - yarns like shetland, lambswool and fancy yarns. - guidance in developing proper counts of yarn for standard merino yarn for Ludhiana.

COMPANY BACKGROUND:

Name and address	:	M/s. Paul Engineers, Industrial area, Ludhiana.
Name of the contact executive	:	Mr. Paul Singh
Nature of operation:		Manufacture of hand-flat knitting machine and sale to Ludhiana knitting industry.
Dates of visit	:	May, 1983 - 14, 16, 18, 20, 23 and 28 June, 1983 - 17 September, 1983- 1
Assistance programme:		Technical assistance and guidance in developing and finally making a prototype model of hand operated intersia knitting machine. Guidance on the use of the intersia knitting machine.

PART - I

Section D - LIST OF PROTOTYPE GARMENTS MANUFACTURED IN THE KNITWEAR FACILITY

LIST OF KNITWEAR SAMPLES DEVELOPED AT THE KNITWEAR FACILITY

Sample No:	Description
KF/306/45	Open cardigan deep V-cut with tuck effect using 2/32s merino wool yarn and 8gg handflat.
KF/306/46	V-neck pullover with deca work and also with collar using 2/32s acrylic yarn and 6gg handflat.
KF/306/47	Open cardigan deca design using wool yarn 2/28s and 8gg handflat.
KF/306/48	T-neck pullover cabledesig using 2/28s wool yarn and 8gg handflat.
KF/306/49	V-neck pullover for ladies - jacquard and self design using 2/29s acrylic yarn and 6gg handflat.
KF/306/50	Children's frock in multi-tuck design using 2/28s acrylic yarn and 6gg handflat.
KF/307/51	Ladies cardigan with tuck and jacquard design using 2/28s acrylic yarn and 6gg handflat.
KF/307/52	Children's pullover half sleeve in multi-tuck design using 2/28s acrylic yarn and 6gg handflat.
KF/307/53	Gents T-shirt half sleeve using 2/32s wool yarn and 12gg handflat.
KF/307/54	Round neck pullover with jacquard spot designs using 2/32s acrylic yarn and 6gg handflat.
KF/307/55	Deep round neck ladies sleeveless blcuse with tuck and self designs using 2/32s acrylic yarn and 6gg handflat.
KF/307/56	Round neck pullover centre cable design using 2/32s acrylic yarn and 8gg handflat.
KF/307/57	Multistriped gents T-shirt using 2/32s acrylic yarn and 12gg handflat.
KF/307/58	Round-neck pullover with pouch pocket cable design in the centrefront using 2/32s acrylic yarn and 8gg handflat.
KF/307/59	Round-neck pullover plain border with jacquard design using 2/32s acrylic yarn in 6gg hand-flat.

List of knitwear samples made - continued.

Sample No:	Description
KF/307/60	V-neck plain pullover in reglan sleeve using 2/28s wool yarn and 21gg fully fashioned machine.
KF/307/61	Open cardigan in tuck and half cardigan knit structure using 2/32s wool yarn and 8gg hand flat.
KF/308/62	Poloneck pullover with vertical line designs using 2/32s wool yarn in 12gg hand flat.
KF/308/63	Round neck sleeveless ladies top using 2/32s wool yarn and 8gg hand flat.
KF/308/64	T-shirt gents with cable design upto chest pocket flaps using 2/32s wool yarn and 8gg hand flat.
KF/308/65	Round neck ladies cardigan plain structure with reglan sleeve design using 2/28s wool yarn and 21gg fully fashioned machine.
KF/308/66	Poloneck pullover with deca transfer and zig-zag design using 2/32s wool yarn and 8gg hand flat.
KF/308/67	V-neck pullover in stripe design using 2/32s wool yarn and 12gg hand flat.
KF/308/68	Child's high neck deca design pullover using 2/32s acrylic yarn and 6gg hand flat.
KF/308/69	Ladies cardigan in poloneck/collar with buttons using 2/32s acrylic yarn and 8gg hand flat.
KF/308/70	Gents cardigan poloneck collar with zip using 2/32s wool yarn and 6gg hand flat.
KF/308/71	Gents cardigan with collar and zip using 2/32s wool yarn in 8gg hand flat.
KF/308/72	Gents Blazer with three patch pockets single breasted using 2/32s acrylic yarn and 8gg hand flat.
KF/308/73	Blazer single breasted with three pockets using 2/32s wool yarn and 12gg hand flat.
KF/308/74	Blazer with three pockets using 2/32s wool yarn and 12gg hand flat (heavier variety).
KF/309/75	Gents cardigan in tuck effect and half cardigan knit structure using 2/32s wool yarn and 6gg hand flat.

List of knitwear samples made - continued

Sample No:	Description
KF/309/76	Gents V neck sports pullover in cable design using 2/32s Shetland yarn and 4gg hand flat.
KF/309/77	Ladies cardigan in shawl collar and builtin pocket style using 2/32s wool yarn and 4gg hand flat.
KF/309/78	Pullover with shawl collar and cable design and pocket (built-in) on the sleeve using 2/32s lambswool and 4gg hand flat.
KF/309/79	Pullover with special polo-cum-open collar design with zip and built in pocket on the front using 2/32s Shetland yarn and4gg handflat.
KF/30980	Ladies round neck blouse with deca design using 2/32s wool and 4gghand flat.
KF/309/81	Ladies blazer with patch pockets and gold buttons using 2/32s wool yarn and 12gg handflat.
KF/309/82	Round neck pullover plain structure general cut style using 2/32s and 12gg hand flat.
KF/309/83	Pullover with shawl collar jacquard design in birdseye and checks knit structure using 2/32s wool yarn and 6gg handflat.
KF/309/84	Round neck pullover with jacquard design - T shirt slit and zip closing using 2/32 s wool yarn and 6gg handflat.
KF/309/85	Round neck pullover with jacquarddesign in front, back and sleeve using 2/32s wool yarn and 6gg hand flats.
KF/309/86	Ladies T-shirt with nehru collar using 2/32s wool yarn and 6gg handflat.
KF/310/87	Round neck pullover with cable design using 2/32s in 8gg hand flat.
KF/310/88	Poloneck pullover with upper part plain structure and lower half in jacquard design with pocket inside using 2/32s wool yarn and 6gg hand flat.
KF/310/89	Ladies sleeveless blouse with cord and belt using lambswool single 16s yarn and 8gg hand flat.
KF/310/90	Roundneck pullover with special cable design using single 16s lambswool and 8gg hand flat.

List of knitwear samples made - continued

Sample No:	Description
KF/310/91	Round neck short-sleeve pullover with deca designs using lambswool 16s single yarn and 8gg handflat.
KF/310/92	Ladies sleeveless blazer double breasted using 2/32s wool yarns and 12gg handflat.
KF/310/93	Gents double breasted blazer in full milano structure using 2/32s wool yarn and 6gg handflat.
KF/310/94	Cardigan with reglan sleeve and zip attachment in half milano structure using 2/32s wool yarn and 12gg handflat.
KF/310/95	Round neck pullover with centre cables reglan cut and tubular borders using 2/32s wool yarn and 8gg handflat.
KF/310/96	Round neck pullover with fancy yarn effect and plain structure and the front and the back respectively using fancy and merino 2/32s wool yarn and 6gg handflat.
KF/310/97	Highneck pullover with jacquard design on the front using 2/32s wool yarn and 6gg handflat.
KF/310/98	Round neck sleeveless pullover with cables using 2/32s wool yarn and 6gg hand flat.
KF/310/99	V neck pullover with two-in-one effect front and back with jacquard and plain sleeves using 2/32s wool yarn 6gg handflat.
KF/310/100	Ladies blazer with collar and three buttons - stripes with side slits using 2/32s wool yarn and 12gg handflat.
KF/310/101	Round neck pullover general cut sleeves using 2/32s wool yarn and 12gg handflat.
KF/310/102	Round neck cardigan gents with zip opening in tuck effect design using 2/32s wool yarn and 6gg hand flat.
KF/310/103	Open neck cardigan with zip opening stripe vertical effect using 2/32s wool yarn and 12 gg handflat.
KF/310/104	Round neck T-shirt half sleeve striped style using 2/32s wool yarn and 12gg handflat.
KF/310/105	Ladies Poncho (shawl type) with open lower part using 2/32s wool yarn and JDR-2 power flat 8gg.
KF/311/106	Roundneck pullover with racking and tubular effect design using 2/32s wool yarn and 8gg handflat.
KF/312/107	High neck pullover with reglan sleeve -knitted in single bed using 2/32s wool yarn and 12gg hand flat.

List of knitwear samples made - continued

Sample No:	Description
KF/311/108	Round neck sleeveless ribbed effect structure top using 2/32s Fancy yarn and 8gg handflat.
KF/311/109	Overlap V neck pullover in French sleeve - single bed knit- using 2/28s wool yarn and 8gg handflat.
KF/311/110	High neck with rib in the front and stripes and the back pullover using 2/32s wool yarn and 8gg handflat.
KF/311/111	Overlap V neck pullover with shoulder straps and 'KF' broach in the epullete using 2/32s wool yarn and 12gg handflat.
KF/311/112	V-neck pullover with leather patches and designs at the shouder and elbow using 2/32s wool yarn and 8gg handflat.
KF/311/113	Ladies blouse half sleeve deca design French sleeved using lambswool 2/32s and 8gg handflat.
KF/311/114	Ladies pullover with half sleeve and special cable design using lambswool 2/32s and 8gg handflat.
KF/311/115	Crewneck pullover in French sleeve with tubular band on the neck using 2/32s wool and 8gg handflat.
KF/311/116	Gents pullover frenchsleeved cable design round neck with T-shirt slit and Zip closing using lambswool and 4gg handflat.
KF/311/117	Ladies blouse sleeveless boatneck tuckeffect design using 2/32s wool yarn and 8gg handflat.
KF/311/118	Ladies sleeveless top with side open using 2/32s wool yarn and 12gg handflat.
KF/311/119.	Round neck pullover with fancy yarn stripes using 2/32s wool yarn (fancy) and 8gg handflat.
KF/311/120	Round neck pullover with jacquard design in the front with plain back and sleeves using 2/32s woolyarn and 6gg handflat.
KF/311/121	Overlap V neck single bed French sleeved pullover using 2/32s wool yarn and 8gg handflat.
KF/311/122	Round neck pullover reglan cut with pouch pocket - single bed knit - using 2/32s wool yarn and 8gg handflat.
KF/312/123	Child's roundneck pullover font and back Jacquard structures and plain sleeves using 2/32s wool yarn and 6gg handflat.
KF/312/124	Child's pullover with cap and string - jacquard design on the chest and around the back and shoulders. reglan sleeves.

List of samples made - continued

Sample No:	Description
KF/312/125	Child's V neck pullover sleeveless with jacquard design next to the border - border with stripes using 2/32s wool yarn and 6gg handflat.
KF/312/126	V neck pullover with front and back in jacquard design and sleeves plain - general cut using 2/32s fancy yarn and 6gg handflat.
KF/312/127	V neck sleeveless with jacquard design with fancy yarn borders using 2/32s merino and fancy yarn and JDR-2 8gg power flat.
KF/312/128	Gents cardigan V neck general cut with 1 x 1 tuck full cardigan structure using 2/32s wool yarn and 12gg handflat.
KF/312/129	Cycling pullover multi colour wit collar and backside box pleats using 2/32s wool yarn and 12gg handflat.
KF/312/130	Gents sleeveless jacket with loops and wooden buttons. Piping all over the front and two patch pockets using fancy yarn and JDR-2 8gg power flat.
KF/312/131	High neck pullover with all over jacquard design using fancy and wool yarn of 2/32s and JDR-2 8gg power flat.
KF/312/132	V neck sleeveless allover design jacquard using fancy and merino wool yarn of 2/32s and JDR-2 8gg power flat.
KF/312/133	V-neck sleeveless pullover with all over jacquard design using fancy and merino 2/32s wool yarn and JDR-2 power flat.
KF/312/134	Roundneck pullover for children- general cut with all over design in jacquard using 2/32s fancy and merino wool yarn and JDR-2 8gg power flat.
KF/312/135	V-neck sleeveless all over design jacquard pullover using fancy and mernino wool yarn and JDR-2 power flat 8gg
KF/312/136	Round neck sleeveless open jacket with golden buttons and two cut-in pockets using 2/32s fancy and merino w8ol yarn and JDR-2 8gg power flat.
KF/312/137	Boat neck pullover with button closing front- with partial application of fancy yarn using 2/28s wool and 6gg handflat.
KF/312/138	Knitted kurta with side neck slit and Nehru collar using 2/32s wool yarn and 12gg handflat..

PART - I

Section E

RECOMMENDED PRODUCTION PROGRAMME FOR THE KNITWEAR FACILITY

Knitted garment making-up technology in the Knitwear Facility's workshop have been perfected so far. Ninetyfour sample-garments were produced with the proper techniques in order to give training to the operatives of various machinery and equipment.

It is however known that only by continuous production practice, the skills of the operators can be developed and maintained to the full extent and only this can give best possible workmanship. The Knitwear Facility, after completion of the second phase, will have modern equipment such as Electronic power flats, circular garment knitting machines and also fully fashioned machine. In addition, the making-up equipment is adequate and up-to-date. It is therefore proposed that these machines and equipment should be utilized on a continuous basis. In view of this, I recommend that the pilot production in sufficiently big scale should be undertaken in the Facility as per the suggested production programme.

PRODUCTION DATA FOR KNITTED OUTERWEAR MANUFACTURE AT THE KNITWEAR FACILITY.

Knitting programme	Production data						
Type of machinery:	JDR-2 8gg(12)	SDR 5gg	Elec. p/flat 8gg	F.F. Cotton 21gg.	SPJ Cir. 8gg	RTR Cir. 14gg.	TOTAL
Weight per garment with long sleeves in wool & wool blend yarn 2/28s or 2/32s	450gms	500gms	400gms	230gms	450gms	220gms or	
" 2/48s for RTR in wool or Textured polyester						160gms	
Capacity utilization(A):							
Production per hour at 100% efficiency (number of garments)	3	6	3	4	7	8 =	31
Production in 8 hours at 80% efficiency(garments)	19	38	19	25	45	51 =	197
Production per month with 26 working days at 80% efficiency	494	988	494	650	1170	1326 =	5122
Yarn consumption (in Kg)							
2/28s and 2/32s	222.3	494.0	197.6	149.5	526.5	=15896.0	
2/48s						291.7= 291.7	
Textured polyester dtex 150-167						212.2= 212.2	
Capacity utilization:							
Production per 8 hours at 50% efficieny (garments)	12	24	12	16	28	32 =	124
Production per month	312	624	312	416	728	832 =	3224
Yarn consumption(in Kg):							
2/28s and 2/32s	140.4	312	124.8	95.7	327.6	=1,000.5	
2/48s						183.0= 183.0	
Textured polyester						133.1= 133.1	

PRODUCTION PROGRAMME FOR ONE YEAR

Capacity utilization per month (production and sampling)	Production Volume Total output	Production per machine (number of garments) JDR-2 8gg(12)	SDR 5gg	Elec. 8gg.	F!F! 2.gg	SPJ 8gg	RTR 14gg
January 50% + samples	3,224	312	624	312	416	728	832
February 80%	5,122	494	988	494	650	1170	1326
March 80%	5,122	494	988	494	650	1170	1326
April 80%	5,122	494	988	494	650	1170	1326
May 50% +samples	3,224	312	624	312	416	728	832
June 50% + samples	3,224	312	624	312	416	728	832
July 50% + samples	3,224	312	624	312	416	728	832
August 80%	5,122	494	988	494	650	1170	1326
September 80%	5,122	494	988	494	650	1170	1326
October 80%	5,122	494	988	494	650	1170	1326
November 50% + samples	3,224	312	624	312	416	728	832
December 50% + samples	3,224	312	624	312	416	728	832
Total:	50,076	4,836	9,672	4,836	6,396	11,388	12,948

Note: The hand flats of 6,8 and 12gg are only for sample making and making of trimmings and accessoires like ribs etc.

Yarn consumption for one year:

	2/28s/2/32s	2/48s	Polyester dtex 167
Six months at 80% efficiency ..	9,591.6 kgs	1,750.2 kgs	or 1,273.2 kgs
Six months at 50% efficiency ..	6,003.6 "	1,098.0 "	or 798.6 "
Total:	15,595.2 "	2,848.2 "	2,071.8 kgs.

The consumption will therefore be
either 18,443.4 kgs (using wool and wool blends only) or 17,667 kgs (using wool and polyester).

MANPOWER REQUIREMENT FOR OPERATION OF KNITTING AND MAKING UP MACHINERY

Machinery:	Manpower	
	Operator	Helper
JDR and SDR knitting machines	1	
Electronic power flat and the fully fashioned knitting machine	1	
Helper for the above 2 operators		1
SPJ and RTR circular knitting machines	1	
Helper for the above operator		1
Hand flats	2	
Cutting	1	
Helper to the above operator		1
3 linking machines (5,8 and 12gg)	3	
2 cup seamers plus 1 cuff closer plus 3 overlock sewing machines	4	
1 buttonhole making machine (with gimp)	1	
2 sewing machines (1 lockstitch and 1 chainstitch)	1	
2 steam presses	2	
General helpers for button sewing, hand sewing etc. etc.		3
Total manpower requirement:	17	6 = 23 persons.

Section A

GUIDELINES FOR PRODUCING WOOLLEN KNITWEAR OF HIGH QUALITY AND WITH DIMENSIONAL STABILITY

INTRODUCTION:

This manual is for the practical use of the production executive of manufacturing enterprises producing knitted outerwear with hand and power operated flat knitting machines using wool - worsted or woollen yarn and blends thereof.

Since this manual has been prepared taking into consideration the skill and knowledge of the local industrial personnel - who are busy with their everyday tasks and will not have the opportunity or aptitude of studying the relevant technical literature which are usually of more academic nature and tend to be too theoretical and cumbersome - theoretical explanations of the topics have only been included wherever it was thought to be necessary for complete grasp of the subject.

To be able to make the best use of this manual, the reader ought to have proper knowledge of knitting and making-up operations.

The knitting industry of Ludhiana is progressing fast with the guidance andhelp of Knitwear Facility but there is still ample scope for imrpovement even by using the existing inputs of :

- yarn and other raw materials,
- machinery and
- skilled manpower.

Following the guidelines of this short manual, the knitters will be able to produce best possible and dimensionally stable garments.

Contents of the guidelines for producing woollen knitwear

I. Preparatory operations:
   A. Winding:
      1. Bottle bobbins
      2. Cross-wound bobbins
   B. Up-keep of knitting machinery
II. Technical aspects of knitting operation:
   a. Breaking strength
   b. Elasticity
   c. Smoothness
III. Inter-relationships of knitting techniques, knit structures and the yarn quality:
   A. Fully fashioned machine knitting
   B. Hand-flat single bed fabric
   C. Hand-flat double bed fabric
   D. Circular knitted fabric
   E. Flat bed power flat knitting fabric
   F. Jacquard Knitting
IV. Fabric making aspects of knitting
   A. Single bed fabrics
   B. Rib fabrics
   C. Milano structures
   D. Cardigan structures
   E. Jacquard structures
V. Creative aspects of knitting
   a. knitting swatches
   b. finishing of swatch-samples
   c. making trial panel
   d. scrutiny by designer and merchandising staff
   e. first prototype garments
      1. fully fashioned garments
      2. cut and sew garments

VI. Making-up operation

A. Making-up of fully fashioned knitwear

1. First method

a) pullovers with reglan and saddle sleeves

b) cardigans of reglan and saddle sleeves

c) pullovers with french sleeves

d) cardigans with french sleeves

2. Second method

a) pullovers of all types

b) cardigans

B. Making-up of cut and sew style garments

1. Preparatory processes

2. Making-up operations

VII. Making-up machinery and their uses for knitwear

A. Linking

B. Cup-seaming

C. Overlock sewing

D. Flat-lock stitching

E. Double chain stitch machine

F. Button-hole making machne

G. Button stitching machine

Remarks:

VIII. Finishing operation of knitwear

a. Swelling of wool fibre

b. Fabric shrinkage.

I. PREPARATORY OPERATIONS

A) WINDING:

The Main task of a correctly wound bobbin (cone) is to allow smooth unwinding of yarn with minimum tension and as little variations of tension as possible,irrespective of the sizes of the bobbins.

For woollen/worsted yarn, three types of bobbins are generally in use:

1. Bottle bobbins

Bottle bobbins which give even yarn flow irrespective of the size of the bobbin or the extent of the yarn unwound from the bobbin is the preferable type but since in this method the winding speed is very slow,it is now used only for high quality low twist expensive yarn such as cashmere.

2. Cross-wound bobbins

The following two types are relevant for knitting:

a) The 9'-15" cones

These types of cones have been in use for about 30 years in the knitting industry. In this method of coning, the tension built-up varies with the diameter of the cones being unwound in the knitting process. Also, being a cross-wound bobbin, the yarn tension accumulates in different degrees at different heights of the cones - the highest tension being at the bottom.

b) The 4'-20" cones

With the 4'-20" cones, the tension is practically same but since the diameter variation between the top and the bottom part of the cone is lesser, the tension difference is less pronounced.

Generally the wound cones will have accumulated different yarn tensions and these irregularities will be transmitted through tensioners to the actual stitch formationprocess which may result in irregularity of stitches. A useful method of reducing the impact of irregular tension during unwinding is to properly and sufficiently lubricate the yarn while the cone is being wound.

Ideally, the cone/bobbin winding should take place as soon as possible after the dyeing processes so that the inherent normal moisture content of the yarn is preserved in the cones. If this is not feasible for some reasons, the hanks should be stored in a room which is cool, not exposed to direct sunlight and has about 70% humidity.

If too dry yarn is wound, even correct storing of the bobbins will not allow the inner section of the yarn wound in the cones to regain the moisture. Therefore, under these circumstances, the inner part of the yarn will offer high resistance during knitting process. Also, there will be substantial difference in the tension between the outer layers and the inner layers of the cones during knitting. This will result in noticeable stitch-length variations even in the same garment blanks. Although this stitch length variation in different parts of the same blank could be tolerated to some extent in the cut and sew styles, it will not be acceptable at all in the fully fashioned garments because of difficulty /impossibility of seam matching while making-up.

If the yarn is not already moth-proofed, precautions should be taken to make suitable arrangements, while storing, to prevent moth attack by spraying chemicals. The temperature of the storage room should also not exceed 35°C as higher temperature may soften the lubricating paraffin wax in the yarn. If this happens, the yarn layers will get stuck to each other.

B) Up-keepf of knitting machinery:

Practically all manufacturers build knitting machines in which the primary stitch forming components such as the needles, needle-beds, knockover bits and the cam systems are sufficiently good and when properly maintained will not cause any major inconvenience during the normal lives of the machines. For satisfactory knitting performance, all these components must work smoothly, ie., with least possible frictions. The needle bed must particularly be always clean and lubricated with appropriate oil. Knitting action necessarily creates some frictions among the needles, the needle-beds and the cams as a result of which tiny metal particles are carried off and accumulated with floating dust and fibre bits into the needle-bed slots. If now, oil with high viscosity is used for lubrication, a thick deposit with the aforementioned accumulations in the slot will be formed. This will resist the smooth movements of the needles. Obstacle to the needle movement causes distorted wale formation with consequent impact on the fabric quality.

In addition, there is the possibility of causing mechanical damage to the knitting machine.
Low viscosity of the recommended lubricating oil will float the undesirable accumulations in the slots mentioned before on the surface of the needle bed which can then be wiped off regularly. To ensure the even and adequate distribution of the lubricant it is recommended to use a spray gun. Depending on the environmental conditions and the extent of usage, the needle beds have to be thoroughly cleaned after some months - generally two to three times a year. For this process of cleaning, the needle beds should be taken out of the frame of the knitting machines. Also, all the needles and the needle resorts (for hand flats) and the jacks and pushers (of the power flats) have to be taken out as well. The needle bed ought to be washed with a solvent such as per /tri-chloro-ethylene or white petrol. This action will transform the residue on the slots into powdery substances which can be easily blown away by means of compressed air pistols.
Of course, the needles and other removed components have to be also cleaned and dried. The next step is to repair the bent tricks (if there areany) and if necessary also polish the knockover bits. Before putting the needles back, light oil should be applied on the needle bed with spray gun. After checking that every needle moves smoothly in the slots, the needle bed can be re-assembled on the machine.

It should be checked to see that all the cams are moving freely and are without excessive signs of usage and damage. If the extent of damage is minor, precise grinding and polishing of the cams should be sufficient. However, if the damage is excessive, the cams have to be replaced. Thereafter it should be checked that the cam box gliding on the guiding rails do not have excessive play but moves within a narrow limit but smoothly. The yarn carrier should also be checked for excessive play and the orifice of the yarn carrier is to be checked to see if it is well-centred. Maintenance of the secondary mechanical systems such as the jacquard system, movement cams, transmission system, knitting programme cummunication system etc. should be strictly maintained/ observed as the machine manual suggests.

II. Technical aspects of knitting operation:

Every knitting process exerts certain amount of strains on the yarn being knitted with. Three of the important properties of yarn have a bearing on the knittability. These are:-

a) Breaking strength

If the yarn does not have a minimum breaking strength, it will not be feasible to even supply the yarn from the bobbins through the tension system to the orifice of the yarn carrier. To be able to knit with, the yarn must have certain breaking strength.

b) Elasticity

A minimum elasticity is also required of the yarn to withstand the strains knitting operation. Loop formation and knockover take place simultaneously in all class of knitting machines except for the fully fashioned machines in which these are two consecutive operations. For this reason, even such yarns which have relatively less elasticity / with low twists can be knitted successfully with fully fashioned machines.

c) Smoothness

Yarn smoothness also plays an important role in its knittability. During knitting, when the lowering cams act on the needle butts, a certain number of needles pull the yarn through the hooks and over the knockover bits. At this crucial period, the yarn passes through sharp angular configurations. The strain on the yarn during its passage can be much reduced if the yarn happens to be naturally smooth (e.g., synthetic textured filament) or if smoothness has been imparted by the application of paraffin wax or other lubricants.

The following aspects must also be looked into:

- to minimise the strains on the yarn, the ceramic or porcelain eyelets through which the yarn passes must be made smooth and friction-less,
- the yarn path from the bobbins to the yarn carriers should also be as straight as possible, ie., with least possible angular paths or deflections to avoid building up of additional tensions in the course of yarn movement from bobbins to yarn carrier orifice, and
- for making neat selvedges, the cymbal and other yarn-flow regulators have to be set in such as way that the tensioners

only take up the yarn from the direction of yarn carrier- rather than from the bobbins/cones.

When the technical state of the machinery is properly maintained and the smooth movement of the yarn is ensured, the knitters using hand-flats can concentrate in actual knitting operations - in the direction of course counting, widening and narrowing of blanks, stitch transfers etc and use least physical exertions in the process.

As for the power-flats operations, normal industrial production will not be feasible unless the aforementioned precautions are taken.

Firstly, the power flat operations exert greater tensions in the yarn path due to abrupt start and acceleration of the machine. Working with inadequately prepared yarn will cause broken selvedges and holes in the fabric as more or less every knot and feeble portion of the yarn will break the yarn during stitch forming processes.

Secondly, all the makes of power flats have very sensitive and reliable stop motions which stop the machines even for minor obstacles in the operation. Use of inadequately prepared yarn will frequently stop the machines. As the powerflat knitter has to supervise the operations of several machines at the same time, he will practically be moving from machine to machine to get the machine (which has stopped due to yarn problem) re-started. With such a state of affairs the majority of the machines will be less than fully utilized and production loss will result.

III. Inter-relationships of knitting techniques, knit-structures and the yarn quality:

The extent of strain exerted on the yarn varies with machine types and knit structures. The following six examples cover nearly the entire knitting techniques and structures employed in the industry today. These have been described in the ascending order of exertions on the yarn.

A. Fully Fashioned machine knitting:

The least demanding is the cotton frame bearded needle fully fashioned machine because the formation of the loops and stitches do not take place simultaneously.

For this reason, even substandard yarn can be knitted sufficiently well with fully fashioned machines.

B. Hand-flat single bed fabric:
This is the next combination which already produces greater strain than fully fashioned machine but a good knitter will automatically adjust his knitting speed to the yarn quality. Since in the single bed knitting, the yarn intake is not more than three times the actual width of needle bed being used, the knitters get sufficient time to identify faults in the incoming yarn, such as too large knots , slubs and also the very thin portions of the yarn.

C. Hand-flat double bed fabric:
Still more demanding is the hand-flat double bed knit strucutes like the ribs, half milano, half cardigan, full milano and cardigan stitches. Even then it is possible for a good knitter to adjust his knitting speed keeping in mind the limitations of yarn quality. In this group of structures, nighest degree of strain on the yarn is exerted by the all needles rib structure. The ratio of yarn intake varies between 1: 6 to 1: 8.
(By way of an explanation, the yarn intake is the ratio of yarn being used in knitting to the size of the needle bed. For example the 3:1 ratio will mean 1 metre bed with needles in action with three metres of yarn required to knit a complete course.)

D. Circular knitted fabrics:
Circular knitting machines - power operated - impart the least strain for all knit structures in the class of the power operated knitting machines using latch needles. The yarn flow in the circular knitting system is regular, ie., non-intermittent and therefore the strain on the yarn is even. Furthermore, all circular knitting machines have variable speeds, so that the working speed of the machines can be adjusted to suit the standard of yarn being used. As practically all the modern circular knitting machinery for making fabric have tape feed or the storage feed system which is even better, any yarn breakage will occur between the bobbins and the feed-wheel. The quality of the fabric can be maintained with no likelyhood of holes and cast-offs.

The second advantage of the positive feed system is that it allows the incoming yarn to be fed with absolute minimum tension, thus ensuring minimum strain on the yarn during the stitch formation.

E. Flat-bed power flat knitted fabric:

With this knitting system, the yarn receives most strain. To be able to knit, at least medium qualityyarn has to be used. In power-flat knitting, the carriage moves at uniform speed across the needle bed and therefore in this system there is no possibility of adjusting the linear speed - unlike the hand-flat knitting system in which, as stated before, the operator adjusts the knitting speed to suit the yarn quality.

For power flat operation, the yarn tension will have to be sufficiently high to enable the yarn tensioners to work properly and the yarn tension remains constant when the carriage moves out of the needle bed and the yarn is not being fed to the needles. On return journey, the carriage imparts , by virtue of its abrupt start and immediate pick up of speed, additional tension to the existing one. Due to this abrupt action of the carriage, yarn tension has been measured to have gone up to 40 grams as compared to the normal tension of about 10 grams when the carriage is in the middle of the needle bed.

F. Jacquard Knitting:

Jacquard knit structures, especially those made with double bed exerts maximum tension/strain on the yarn because, in addition to the tension created by power knitting system, intermittent yarn flow, demanded by jacquard structures, causes great variations in tension throughout the whole needle bed during stitch formation.

IV. Fabric making aspects of knitting:

High quality garments should have the different components such as cuffs, waist bands etc. with sufficient elasticity to ensure good fit. Especially, attention should be given tothe start of the first course of knitting. Direct start on hand knitting machines with comb and wire (i.e., the first row of stitches forming the bottom edge of the garment panel) will always give too loose bottom edges. It is advisable to make the start by knitting cotton or any other waste yarn, knit only some rows and then make a fresh start with the selected yarn,where the first row of stitches can be knitted with much more consistent and better looking bottom edge. For knitted garments, generally rib borders (1 x 1, 2 x 1 ribs etc)., are made but many other garments like ladies outerwear - fashionable ones in particular- may also have tubular welts/borders. As for the knitstructures for the body of the garments, the most known are the single bed, rib fabric , half milano, full milano, half cardigan and full cardigan. In power flat knitting, combined structures are more common.

The knit-structures with possible variations are elaborated in the following sections:

A. Single bed fabrics

As single bed fabrics are used mostly for classic style fully fashioned garments, not much designing scope with knit structures exist. The variations of single bed fabrics are :-

- stripes in colour (horizontal)
- stripes with different material (horizontal)
- high and low butt designs
- small designs in single bed two to three colour jacquards
- intersia
- tuck designs (such as pineapplems stitches, pique la coste)
- transfer designs on the same needle bed as the lace design or petinet.

Note:

Most of these designs can be made on the fully fashioned machines as well.

B. Rib fabrics (double bed knitting):

There are many variations possible in rib fabrics. Examples are:

- the 1 x 1 rib
- the 2 x 1 rib
- the 2 x 2 rib
- the 3 x 2 rib
- the 3 x 3 rib etc.etc.

It is also used in conjunction with special transfer designs such as cable stitches/designs for variety in designs. Other variations of ribs are:

- horizontal stripes in colour and with different material
- combination of single bed with rib - used also in the so called 'blister-stitch' which gives a three dimensional effect to the fabric.
- many other structures with needle set out or racking or both combined.

For higher quality garments, it is usually also knitted by widening and narrowing to fully fashioned shapes with handflats or modern electronic power flats.

C. Milano structures:

Half and full milano gives suitable fabrics for outerwear garments - jackets, blazers etc. Half milano fabrics have two separate and distinct faces and each can be used, as desired, as the outerside for the garment.

Full milano has identical faces on both sides. In general, no design variations are used in either milanos but it is technically feasible to make the variations with :

- stripes (horizontal)
- needle set outs
- transfer knits

Higher quality garments in milano knits are also fashioned.

D. Cardigan structures:

Half and Full cardigan stitches give a distinct sporty look. It is generally used for sportswear in coarse gauges for heavy garments. Cardigan stitches have both faces identical. But half cardigan has two different faces. The front face with all stitches showing is used as the outerside of the garment. It is possible to combine these structures with:

- stripes
- needle set outs
- racking (this gives three dimensional effects)

E. Jacquard structures:

Jacquard knitting, in commercial scale is usually done on power flats (mechanical or electronic). Types of jacquards are :

- plain colour jacquards
- structural jacquards.

The plain coloured jacquards can be in two, three and four colours with striped backside or birdseye backside. The weight of the knitted panels can be influenced to some extent by the use of different knitting techniques forthe backside(underside) of the garment. Use could be made of :

- striped backing
- birds-eye backing
- others

Structural jacquards can be knit with any combination of stitch, tuck or miss and transfer designs. An example of this is the cable design and another is the blueberry design. Purl stitch structures can also be made by taking advantage of the stitch transfer (Links-Links).

Plain and structural jacquards are generally knitted in rectangular garment blanks for cut and sew styles. Owing to the pattern programming capacity being almost limitless in the electronically controlled power flats, any of the aforementioned structures can be knitted in the fully fashioned (shaped) blanks as well.

V. Creative aspects of knitting:

For any given kind of knitted garments, there is always the ideal combination between the machine gauge and the yarn count but in practice this may not always be possible to attain due to the limitationsof machinery, yarn and the operator skills available in the factory. Compromises, therefore, have to be made to come nearest to the desired combination. The most important consideration for a manufacturer of knitwear is the price limit of the end product- pullover or cardigan etc.

As there is a limit below which the cost of labour and other inputs cannot be reduced for any given garment style and since there is also a ceiling above which the selling price cannot be increased, the likely sale price of the style determines the amount which can be invested for the yarn.
Alternatively, there can be the pre-determined end-product and the manufacturers must attempt to achieve the best realistic results from the various inputs such as yarn, knitting and making up operations etc.
In order to arrive at the best combinations of machine gauge, yarn type and knit structure, trials have to be conducted by practical knitting of swatches and blanks. The following procedure is recommended for this exercise:

a) Knit, in the chosen knit structure, three swatches of 30cm x 30cm size in three different stitch length settings. Ideally the colour of the swatch used for trial shouldbe medium - not too light nor too dark.
b) If as a result of the knitting trials, a group of likely swatches, with different stitch settings, come up, the next step is to conduct a finishingtrial with the swatches to see and be able to select the most likely settings for the given garment.
c) Thereafter, a panel of approximately 50 cm x 60 cm has to be knitted in the chosen stitch setting and put through the finishing processes to see the results. The panel can then be examined for the following characteristics:
   - weight per square metre as this will enable one to estimate the likely weight of the made-up and finished garment.
   - elasticity, course and wale wise
   - resistance to deformation
   - pilling and snagging test if necessary
   - clarity of stitch definition.
d) After successful trials as mentioned before, the panel must be referred to the designer/merchandising staff so that they may judge the panel against such non-technical criteria - the drape, handle, appearance and wearing performance.

e) Depending upon whether cut and sew style or fullyfashioned style is to be made, the next steps would be as follows :-

1) For fully fashioned garments:

Dimensional calculations for the front, back and sleeve panels have to be made according to the style frompaper patterns. The style could be classical - as reglan, saddle, french and general sleeves or may be fashionable styles as the box, butterfly, Dolman or other unconventional styles, of sleeves. The panels have to be then finished to bring these to the final dimensions - checking against the paper patterns. Trimmings and accessories like collars, pockets etc. will have to be knitted and finished. Thereafter, the compatibility of these components have to be examined in the context of the main body panels.

2) For Cut and sew style garments:

For the first garment sample, the panel should be made big enough to allow the pattern maker ample opportunity to make one trial garment of the desired size.

Trimmings and accessories with uncut panels have to be atleast steamed (preferably dry-cleaned) to achieve relexation shrinkage before making up.

The panels and trimmings have to be examined for compatibility.

The first prototype garment will allow a judgement to be made about:

- whether it is acceptable for further elaboration/ it is to be rejected,
- approximate/provisional costing of the product, and
- production feasibility.

VI. Making-up Operations:

After knitting, the panels - front, back and sleeves - have to be inspected for holes or other damages. Inspection of panles can be done during assembling of the knitted panels, if possible, against an illuminated table. If any repairs are necessary it should be undertaken at this stage.

All the panels should be colour coded with coloured threads for each size lot so that the size batches can be distinguished easily later on after dry-cleaning.

A. Making up of fully fashioned knitwear (two methods):

1. First method

After sewing the last (top) row of stitches against unroving, with overlock stitches, panles and accessories are drycleaned or steamed. It is advisable to use mesh bag(nylon) for the trimmings and accessories.

The following makin-up procedures are recommended:-

a) pullovers with reglan and saddle sleeves

- join the four shoulder seams by cup seaming (alternatively by linking),
- cutting of neck and attaching of collar by linking,
- close side seams, except the ribbed borders, by cup seaming,
- closing of rib borders,

b) cardigans of reglan and saddle sleeves

- join the four shoulder seams by cup seaming - or by linking,
- cutting of neck line and front slitting,
- attaching the tape in front,
- hemming,
- neck linking,
- side seam closing,
- rib closing,
- buttonhole making,
- button-stitching,

c) pullovers with french sleeves

- joining shoulders by linking,
- joining body and sleeves by linking
- side seaming,
- rib closing,
- neck cutting,
- collar attaching,

d) cardigans with french sleeves

- joining shoulders by linking,
- joining the body and sleeves by linking,
- Cutting of neckline and front slitting,
- attaching the tape in the front,

- hemming,
- neck linking,
- side seam closing,
- rib clothing,
- button-hole making,
- button stitching,

2. Second method

a) Pullovers of all types

- joining the front, back and sleeve panles by linking or cup seaming,
- drycleaning the assembled garment and the trimmings,
- cutting neck and linking the collar
- closing side seams, except the rib borders by cup seaming,
- closing the rib borders,

b) Cardigans

- assembling of the front, back and sleeve panels except the sideseams
- drycleaning with the trimmings
- cutting the neck outline and slitting the front,
- attaching the front tape,
- undertaking hemming,
- neck linking,
- side seam closing,
- rib closing,
- button hole making,
- button stitching.

B. Making-up of cut and sew style garments:

1) Preparatory processes

- Steam or dryclean the garment panels. When the knitted panles come out of the knitting machines, the fabric is usually distorted. Fir relaxation of the knitted panles, one can dryclean but heavy steaming should bepreferred becasue the distorted panles can be easily brought into rectangular shape for cutting.

- Depending on the pattern, the panels can be cut in several layers at a time if there is no chance of subsequent difficulty in matching the cut components (front with sleeves for example). When the patterns such as stripes, checks etc. have to be matched, it is advisable to cut single layers of fabrics. It goes without saying that only the use of paper patterns can give satisfactory results.

  There are three established machine cutting systems. These are:

  a) rotary knife cutting,

  b) straight knife cutting and

  c) bent knife cutting.

  Thick layer of knitted fabric is best cut (most accurately) with the band-saw cutting system. Lesser thick layers of fabrics are best cut with rotary knife cutting machines. The straight knife cutting system is mostly used for running length heavy knitted fabrics and also for the woven fabrics.

2) Making-up operations

It is not possible to make a general outline or workplan for making up of cut and sew knitted garments because there could be any combination of the following operations :

- overlocking,
- serging,
- chain stitching,
- lock stitching,
- hemming,
- linking,
- cover seaming,
- zig zag stitching,
- decorative seaming , etc. etc.

VII. Making up machinery and their uses for knitwear

A descriptionof the different machinery and seams used in knitwear making up is illustrated below :

A. Linking:

a) single chain stitch linking is elastic but cannot be recommended because if the seam breaks even only at one place, the chain stitch may unravel gradually. The stitch forming thread usually is the same wool as used in the knitting.

b) double chain stitch linking withtwo wool threads are used fcr most knitwear but for the garments like sports-wear, the needle thread should be a sewing thread as these garments seams are subjected to a great deal of strain.

When only wool thread is used for linking, frequent checkingof elasticity and tenacity of the seam has to be done by the supervisors - at least everytime the colour is changed.

Two systems of linking (type of machine construction) are in use. These are :

- the needle inside out,
- the needle outside in.

Although for every specific linking operation there is the ideal choice between the two alternative methods, generally use of outside in for the sake of practical convenience is made as this enables visual inspection of the right side of the garment while the linking operation is going on.

B. Cup-seaming:

As in cup-seaming, the elasticity of the seamis not as large as the linking, small to medium stitch length should be used. Tension of the needle thread should be strong for neatness of the seams.

C. Overlock sewing:

The most frequently used type of overlock machine for cut and sew type of garments are:

a) single needle/thread (one needle with sewing thread and two loopers with wool) overlocking is used for general seaming and serging. Hemming is done with special guides.
b) two needle four thread double seam (two sewing threads in in needles andtwo wool threads in the loopers) overlocking is used for general seaming as this gives protective seams in front of the covered overlock seams.
c) two needle five thread safety stitch overlockingis the ideal one for heavy duty sportswear as the protective seam is formed by double chain stitch seam using in the needle and the looper sewing threads. Main overlock seam is the same as mentioned in 'a)' above.

D. Flat lock stitching:

This straight stitching is practically not elastic, so the stitch length must be small and only best possible sewing thread in the top and bottom(spool) should be used. If possible use of a machine with zig-zag stitching is recommended whereever possible. For parallel seams, attachingpockets or other operation which must be very precise, appropriate guides should be used.

E. Double chain stitch machine:

In double chain stitchs, the seam has on the right side the same appearance as that of lock stitch. It is also elastic. If a substantial part of the production can be used for double chain stitching, utilization of this machine is recommended.

F. Button-hole making machine:

Four different types of buttonholes are used in the garment manufacturing industry and machines of each type are available. These machines are:

a) single thread chain stitch button hole - used for economical production of woven garment like shirts,
b) lockstitch type of buttonholes - generally used for better quality woven garments and knitted underwear, T-shirts etc.,
c) lockstitch buttonhole with gimp is used for better quality knitted garments (gimp is a thick thread intelaced in the top seam or right side of the garment and gives a clean and decorative appearance to the buttonhole),
d) Reece buttonhole making machines with gimps using possiblity which should be used for high class garments. In this kind of machine, different forms of eyelets are also possible to make. But the servicing and operationsof this machine is very cumbersome and therefore a Reece factory trained mechanic is required.

G. Buttong stitching machine:

Two types of button stitchings are found in the garment manufacture.

a) The single thread chain stitch variety. Care has to be taken to ensure that the thread is trimmed as close to the button as possible, as otherwise the stitches may get unravelled by pulling end of the thread.

b) Lock-stitch button sewing variety. Most machines are equipped to sew two and four hole buttons of different sizes and diameters.

Most of the previously mentioned machines can be equipped with automatic components like needle positioners, auto-start and stops, seam programming (for pockets etc.). The investment for these additives /auxiliary devices are sometimes more than for the machine-head themselves. Therefore, use of the automatics can be made to a sufficient extent only when bulk production is possible- especially for the assembly line production system.

For bulk production, special purpose machines can also be used. Examples are:

a) back tacking machine

b) label stitching

c) blind stitching.

Remarks on control of seam quality and performance:

Well organized production outfit have tendencies to overlook this basic and important area. Even with today's sophisticated and well constructed machinery, some slight changes (even if involuntary) of stitch length, differential feed, thread tension, thread quality etc. may result in poor seam performance. Very strict supervision has to be maintained by the supervisors in the matter.

VIII. Finishing operation of knitwear:

Three dimensional changes occur in wool and wool blend knitted garments when in contact with water as in washing. These changes are:

- swelling of the wool fibre (Hygral expansion),
- fabric shrinkage (relaxation shrinkage) and
- felting and subsequent shrinkage.

Generally speaking, the knitter has to take into consideration only the points 1) and 2) mentioned above.

a) Swelling of the wool fibre. Every natural and synthetic spun or even filament yarn will 'swell' to a certain extent, in the process of washing or dry-cleaning. Nearly all of the applied spin-finishes, oils, paraffin wax and also the dust and dirt are dissolved. Every single fibre or filament will put itself in the most relaxed position.

The amount of 'swelling of wool yarns will vary depending on the spinning system. High quality fine count worsted yarn will swell very little whereas coarse count woollen yarn will swell much more especialy if some milling is undertaken.
When milling process is being undertaken, the knitter and the finisher must collaborate closely. Depending on the knit-structure, trials have to be undertaken in different stitch-length settings.
Several samples have to be finished in acquaous media or solvent media with addition of water, varying the time of operation concentration of detergents and chemicals until the desired degree of milling is achieved. However, it is not possible to establish a 'recipe' for milling even only for one kind garment style because the result will vary in every spinning lot and even for the same spinning lot of different shadesof yarn. Only expertise and experience of the finishing operator will give good results.

b) Fabric shrinkage (relaxation shrinkage) will occur in any knitted or woven fabric made of spun or filament yarn. Fabric, when not relaxed adequately will create serious problem in making-up. There are no practical means to determine the amount of shrinkage. One cannot beforehand estimate the possible variationsof length and width in the finished garment. If this is already difficult with the woven fabrics, where mechanical shrinking processes can be applied (Sanforizing for instance), no fully reliable finishing process for complete shrinkage of knitted fabrics has been found until now.

Relaxation of knitted garment lengths is relatively easy to achieve to a full extent. For garment blanks and trimmings and accessories complete relaxation can be undertaken by single drycleaning process and for light garments even steaming and subsequent cooling is sufficient.

ANNEX I

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO

PROJECT IN THE REPUBLIC OF INDIA

18 February 1983

JOB DESCRIPTION

DP/IND/82/006/11-02/A/31.7.B

Post title Knitting technologist

Duration Nine months

Date required As soon as possible

Duty station Ludhiana

Purpose of project To strenthen a central knitting industry service and development facility in Ludhiana, established to provide technical services to the knitwear and related industry in the state of Punjab.

Duties

Attached to the Punjab State Hosiery and Knitwear Development Corporation and working under the general guidance of the Chief Technical Adviser of the project the expert will :

1. advise on how to organize the facility's knitting workshop
2. train the technical staff in technical assistance work
3. work in close co-operation with the dyeing and finsishing departments of the facility, introducing methods of manufacturing knitwear of high dimensional stability
4. assist the design unit of the facility in developing new products
5. prepare training courses to be conducted by the facility for industrial/technical personnel
6. advise on questions related to quality control
7. prepare a final report in the form of a reference manual

..../..

Applications and communications regarding this Job Description should be sent to:

Project Personnel Recruitment Section, Industrial Operations Division
UNIDO, VIENNA INTERNATIONAL CENTRE, P.O. Box 300, Vienna, Austria

V.83-52395

to guide the facility's staff in their technical assistance and product development work.

Qualifications: Knitting technologist with extensive experience in fully-fashioned and flat-bed knitting of wool; ability to modify designs produced on automatic machines for production on manually operated flat-bed machines.

Language: English.

Background Information: The knitwear industry in the Punjab State is concentrated around the town of Ludhiana and comprises about 2,000 manufacturing units. About twenty of these are medium-scale and account for some 97 per cent of the country's knitwear exports. The rest are small-scale units. The industry uses imported wool and acrylics spun by small and medium-scale spinners in Ludhiana and Amritsar. The general practice is to contract out the winding, dyeing and garment finishing operations to small, independent firms. The industry as a whole employs about 200,000 people.

In order to help the knitwear industry improve the quality of its production and increase and diversify its exports, the State Government established a common facility for technical services, training and demonstration, in 1980. UNDP/UNIDO supported this effort by providing technical expertize, financing much of the facility's equipment and by training its staff through fellowships and study tours abroad. The facility is now functioning and covers the yarn preparation , dyeing and finishing operations. It is currently being extended to incorporate worsted yarn spinning, flat-bed and body-length circular knitting and finishing. UBDP/UNIDO assistance will provide expertise in worsted spinning, circular and flat-bed knitting, maintenance, the organization of training programmes, dyeing and finishing of knitwear, design of knitwear and colour matching. UNDP/UNIDO will further contribute the necessary equipment for the processes mentioned and finance the required fellowship training of the facility's staff.

The facility's principal equipment items are listed below :

1. Spinning
   - Yarn preparation
   - Worsted spinning

2. Knitting
   - Two circular body-length knitting machines with jacquard attachments
   - Links-links body length machine
   - Fully-fashioned machine
   - Automatic jacquard flat-bed machine
   - Hand flat-bed machine

3. Dyeing
   - Tumbler drier
   - Hydro-extractor
   - Side paddle garment dyeing machine
   - Hank dyeing machines
   - Hank drier
   - Mini boiler
   - HT package dyeing machine
   - Sample hand-dyeing machine
   - Sample package machine
   - Sample package drier

4. Dyeing Laboratory

   - Single cone package dyeing machine
   - Beaker dyeing machine

5. Finishing

   - Spotting table
   - Solvent dry cleaning and finishing machine
   - Three-stage finishing machine
   - Steaming and heat setting press
   - Air-operated knit goods press
   - Equipment for shrink-resistant treatment of tops
   - Winch dyeing and bleaching machine.