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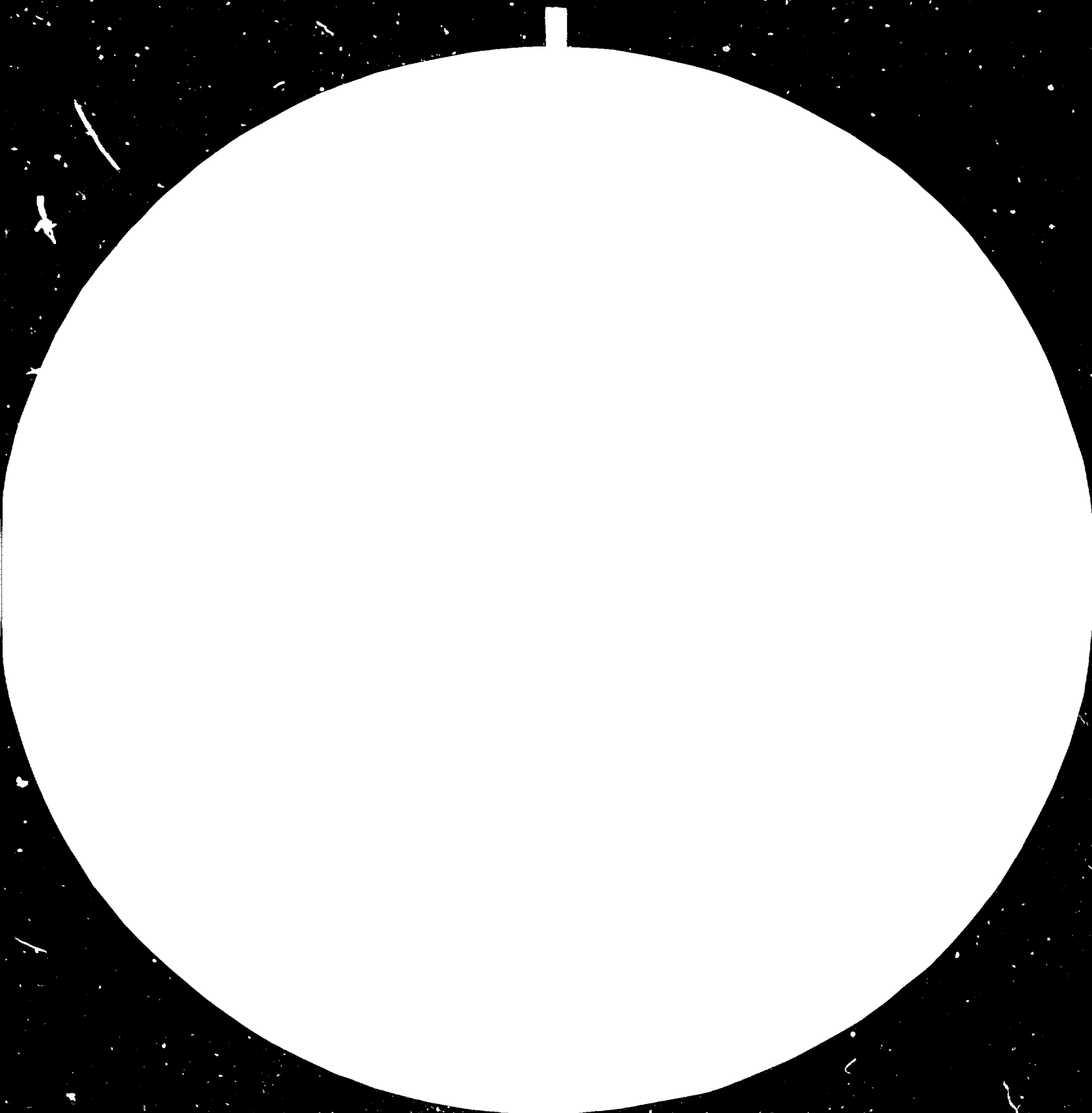
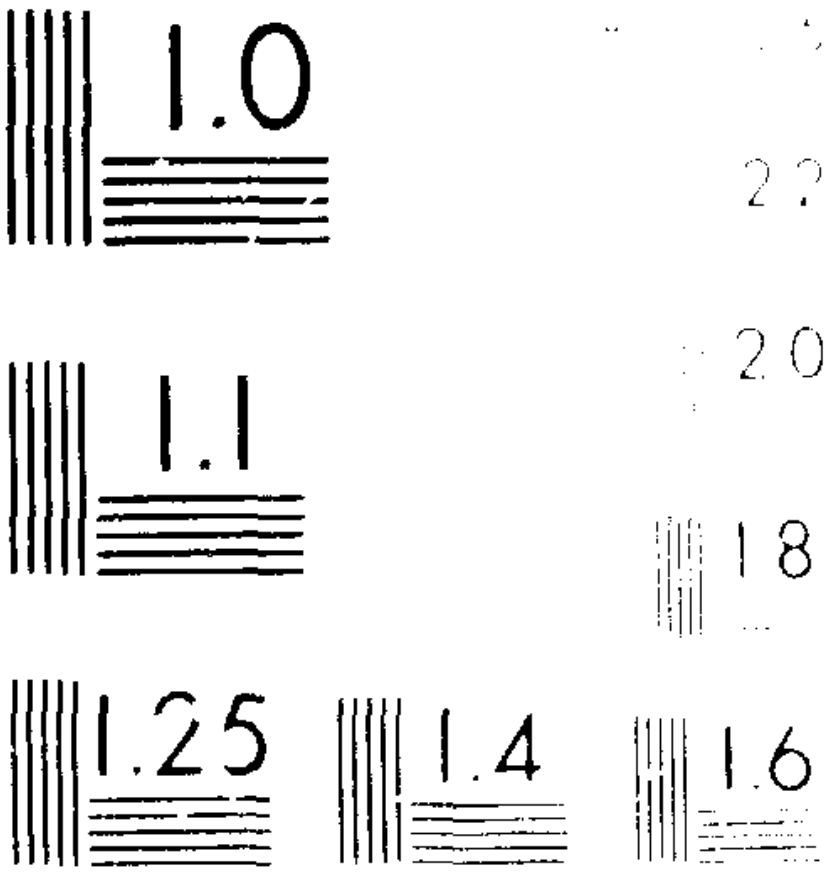
UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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DP/ID/SER.A/313
25 September 1981
English

DEVELOPMENT OF THE HOSIERY KNITWEAR INDUSTRY
LUDHIANA (PUNJAB)

DP/IND/73/021
INDIA

Technical report : In the field of quality control and worsted spinning *

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 John R. Tindall
Quality Control and Worsted Spinning Expert

United Nations Industrial Development Organization
Vienna

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Summary of report

An analysis of the yarn quality from local spinners showed that in the majority of cases it was below generally accepted limits. The market spread of the industry in Ludhiana is heavily biased to the U.S.S.R. business. As this does not appear to be a critical market there is little incentive for the spinner to improve his yarn quality. It is very encouraging, therefore, that several local spinners have requested information from the Facility regarding testing equipment required to start up Quality Control Laboratories.

A review of many technical visits to Worsted Spinning factories in the Ludhiana district showed that machinery maintenance was almost totally ignored. The mechanical condition of processing equipment has a direct effect on product quality. Yarn quality would be immediately improved if simple maintenance programmes were carried out. The Facility is now proceeding to be instrumental in providing maintenance schemes for local factories. It is recommended that this aspect of the Facility's function is pursued enthusiastically both in a practical way and also with the provision of instructional courses to be held at the Facility.

Consideration of the yarn clearing installation in the Winding department of the Facility confirmed that the mechanical clearers are unsatisfactory and should be replaced at the earliest opportunity with clearers of the electronic type.

Information regarding expected yarn quality level, production waste losses, quality control procedures and methods of selection of raw materials has been provided and will be used as control data for dissemination by the Facility into the local industry.

During technical visits to local factories confidence was shown in the Facility's capabilities to provide technical assistance. The Facility is now well equipped in this aspect with the appointment of the R + D Officer, the Training Officer and Assistant Dyeing Master. Liason between the Facility and industry has developed and has enabled the activities of demonstration and technology transfer to be successfully carried out. This function will be further strengthened when the Technical Co-ordinator who will be deputy to the Executive Director at the Facility is appointed shortly.

The technical calibre of all members of the management was of high standard and all were very competent in the execution of their duties. Excellent technical co-operation within the Facility existed.

Introduction

The project DP/IND/73/021 - Development of the Hosiery and Knitwear Industry, Ludhiana was approved by the Ministry of Finance, Department of Economic Affairs and UNDP on 2nd June 1977.

The project became operational with the delivery on site of the first UNDP equipment in February, 1978. The project was originally scheduled to be completed in mid 1980 but this date was later rescheduled to mid - 81. The Tripartite Review Meeting covering the period October, 1977 - May, 1980 was held on 18th June 1980.

The budget has also been revised to reflect the actual and anticipated expenditures through the life of the project.

The executing agency of this project is the United Nations Industrial Development Organization (UNIDO) and the co-operating agency is the Ministry of Commerce acting through the Punjab State Government. The Punjab State Hosiery and Knitwear Development Corporation (PSHC) was established to act as a body through which the services and facilities would be rendered to industry. Thus, the establishment of the PSHC locally known as the Facility is the vehicle through which UNIDO assistance is provided.

The purpose and ultimate objectives of the concept were to overcome the shortcomings of the knitwear industry in the Punjab in its efforts to diversify its export markets towards hard currency areas. To this end the Punjab Government proposed the establishment of the central hosiery knitwear facility in Ludhiana to undertake by modern methods and on a limited scale the operations of yarn winding, clearing, dyeing and shrink resist treatment, knitting and the processing and finishing of garments. In addition to diversify the production range the facility will eventually need to include drawing and spinning, double jersey knitting and fabric finishing. The above is in line with recommendations contained in a report prepared by the International Wool Secretariat in October 1968 and in subsequent reports.

To supplement the technical inputs to the project an economic and marketing unit has been added to the facility to collect analyse and disseminate market information for the small scale sector as well as for the facility itself.

The facility is designed to function primarily as demonstration, training and technical assistance unit. Secondarily it will provide a common facility service particularly for the small scale units. The latter aspect will cover less than ten percent of the industry's requirements. The facility will perform five distinct but related functions:

a) in relation to the important medium scale concerns in the industry on which the export trade at present depends it act as a demonstration unit on the basis of which the State Government will encourage the establishment of one or more similar units by the leading knitwear producers;

b) in relation to the small scale concerns it will act initially as a common service facility undertaking operations on a contract basis in the fields of its competence for producers who wish to make use of it, thereby improving the standard and uniformity of the materials used by those producers and the quality of their products (there services will be available to medium scale producers on demand, but the smaller concerns will normally have priority);

c) at a later stage it is intended to use the facility as a prototype for the establishment of at least one similar unit on a co-operative basis by small producers themselves;

d) the facility will act as a medium for introducing and adopting foreign technology innovations and assist in the development of indigenous technology;

e) the facility will also perform as a training centre for the hosiery and knitwear industry and keep the industry up-to-date as regards styles and designs for the export markets.

The facility will primarily benefit the small sector. Even through only 20 out of approximately 2,000 units control 97 percent of the country's knitwear exports. Over 70% of the exported garments are knitted by the small scale knitter or cottage sectors for and on behalf of the medium scale units. Therefore, even through the facility will process yarn and finish garments for the larger units in effect the real benefit will go to the small scale type units for their development and technical improvement.

The objectives of the project are:

1) Long-range objectives

The long range objective of the project is to increase and diversify exports of Indian knitwear. This will be done through quality improvement to reach and to maintain Woolmark Standards for wool and equivalent standards for other fibres.

2) Immediate objectives

i) To demonstrate and train in advanced methods of singles yarn clearing, twisting, winding scouring, dyeing and moth proofing of yarn in package and hank form for the manufacture of knitwear products and shrink-resist treating of yarn in hank form;

ii) To demonstrate and train in the knitting operations of full-fashioned automatic V-bed and Jacquard hand flat and in the making up of garments;

iii) To demonstrate and train in garment scouring, shrink resist milling, bulking and dyeing;

iv) To demonstrate and train in advanced methods of knitted garment cleaning, pressing and finishing;

v) To provide common services and technical assistance, particularly to the small scale sector, in the above areas;

vi) To provide the industry with information on market and fashion trends and product designs and styles on a continuous basis.

Previous Missions

The establishment and objectives of the project have been endorsed and recommended by various missions, who have surveyed the Ludhiana knitting industry in the past decade, both from overseas and indigenous sources.

Examples of such surveys are the visit to Ludhiana in mid 1975 of a UNIDO knitting technologist consultant Mr.Bary E.Mademam arranged by TDA (Trade Development Authority, Central Government Undertaking) and UNIDO. A visit by Mr.Neitherwood and Mr.H. Krakovian I.W.S.Headquarters consultancy section U.K. arranged by State Government with I.W.S. Indigenous surveys of the knitting industry have also been carried out by TDA and HHEC (Handicrafts and Handloom Exports Corporation of India) a subsidiary of T.D.A.themselves.

All the surveys confirmed the low quality of yarn, technology lag and necessity of a project to introduce demonstration and training to upgrade quality, from yarn manufacturing to garment finishing. The services in particular to assist the small scale industry through providing a common service facility. The ultimate goal being to expand and diversify exports into new markets.

Outline of Official arrangements

The dates of authorization and signature of the project document are as follows :-

Ministry of Finance Dept.of Economic Affairs on behalf of the Government	18.4.1977
UNIDO Letter No. Ind 109 on behalf of the Executing Agency	3.5.1977
Resident Representative in India on behalf of the United Nations Development Programme	2.6.1977

The estimated starting date was September,1975 with a duration of 4 years 10 months which meant a completion date of June 1980. However, due to unforseen circumstances the starting date was delayed to September 1976, therefore concludes June,1981.The total financial inputs by the

Government and UNDP/UNIDO are as follows :-

Government US $ 1,205,358(converted from Rs.at 8 Rs.1 $)

UNDP/UNIDO US $ 2,141,635

(Original contributions stated on the project documents were ;

GOVERNMENT CONTRIBUTION	Rp 19,313,500
UNDP CONTRIBUTIONS	US $ 1,379,650

Work Plan(Accompanying Table I & II)

The Accompanying work plan, records the activity of the Facility from 1975 to May/June 1981.

Training Officer took up appointment, July.

Research and Development Officer took up appointment, July.

Assistant Dyeing Master took up appointment, July.

Appointment of a deputy Executive Director for the Facility will be finalized very shortly.

Contd....

TABLE I

Work Plan

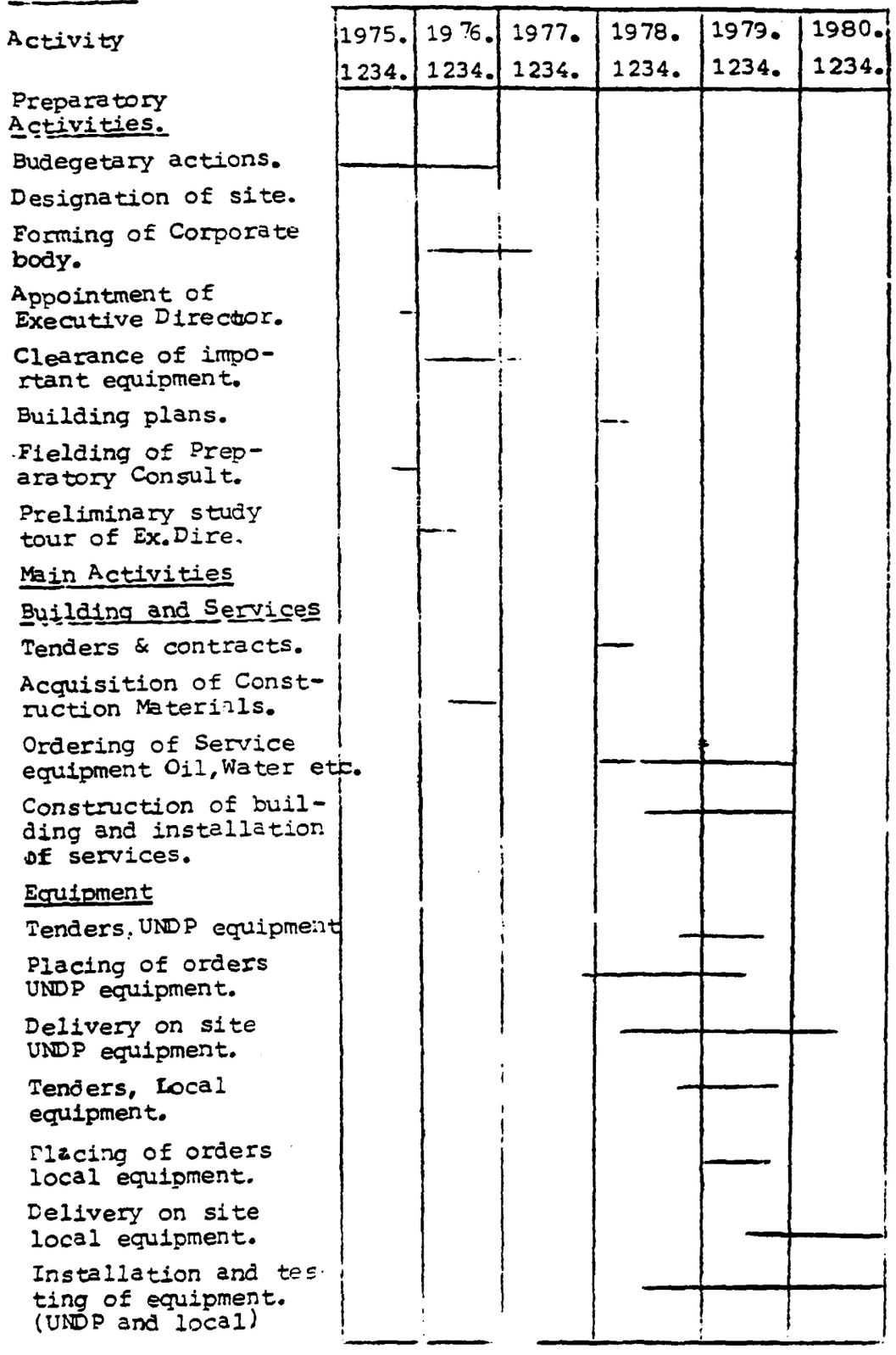


TABLE II

Activity	1975. 1234.	1976. 1234.	1977. 1234.	1978. 1234.	1979. 1234.	1980. 1234.	1981. 1234.
Staffing							
Selection and appointment of main technologists.				—			
Appointment of Chief Engineer.				—			
Appointmentqof Economist and Office Manager.			—				
Recruitment of rest of the staff.			—	—	—	—	
Fielding of Foreign Experts							
Technical Adviser.					—	—	—
Short-term Consultants.							—
Training							
Second Study tour of Executive Dir.					—		
Fellowship for dyeing master.					—		
Followship for finishing master.					—		
Quality Control & winding fellowship.					—		
Reviewsand Reports.							
Mid-term review.						—	
Technical Adviser's Terminal Report.							—
Operationed Activities							
Prep.of training programmes.							
Training of For.personel.							
Training of Ind.personel.					—	—	—
Provision of Serv. to Industry.				—	—	—	—
Collection & dissemination of Information.					—	—	—

A UNIDO technical expert in Quality Control and Worsted Spinning, Mr.J.R.Tindall, undertook a two months "Assignment" at the Facility from June 21st 1981 to August 20th 1981. The duties of the Expert were to took work in co-operation with the Punjab State Hosiery and Knitwear Development Corporation in areas of Worsted Spinning and Quality Control as specified in the Job Description (Annexure I)

Recommendations

1. Machinery Maintenance Local Ludhiana Spinners

As a result of many factory visits and following a lecture delivered at the Facility covering the topic of machinery maintenance, much interest has been generated in this subject amongst the local industry. A number of requests have been received by the Facility for information and technical visits relating to machinery maintenance. It is recommended that the Facility concentrate much effort on this function as it is a fundamental requirement of the yarn quality improvement programme. It is suggested that the Facility run instructional courses on this subject.

2. Technical Liason. Facility - Local Ludhiana Spinners

The Facility's technical advice function is now well established and with the recent appointments of Research and Development Officer, Training Officer and Assistant Dyeing Master have competence in all areas. This area will be further strengthened with the imminent appointment of a technical co-ordinator who will be deputy to the Executive Director. It is recommended that the competence of the staff is further utilized to enlarge this very important function of the Facility.

3. Single Yarn Clearing Installation

The mechanical clearers fitted to the Winding frames at the Facility are not satisfactory. It is

recommended that electronic yarn clearers are fitted to the relevant winding machines at the earliest opportunity. PSHC have already received recommendations for the electronic clearer installation

4. Quality Control - Ludhiana Worsted Spinners

It is encouraging that certain spinners have asked for information on equipment to set up Quality Control laboratories. Obviously this aspect of the Facility's role should get as much exposure as possible by demonstration etc. To this end it is recommended that the items of testing equipment listed in Annexure XIII (for possible purchase during Phase II) are brought forward to be incorporated into the Facility laboratory as soon as possible to be prepared for increased interest in this area.

3:1) Review of Visits made to spinning units in the local Ludhiana district

Details of actual visits made are contained in Annexure II.

In discussion with plant directors etc. it was revealed that generally even basic machinery maintenance was ignored. Old machines were greatly in evidence but the lack of maintenance factor was the largest contribution to the extensive poor yarn quality. (See Annexure VI). The lack of clearing was almost universal and the only yarn "Clearing" carried out was often visual examination of the yarn in hank form by a group of operatives. Quality Control laboratories of a reasonably comprehensive type, with suitable testing equipment, and controlled atmospheric conditions were seen at about one third of the factories visited but they related exclusively to the top making operations and were primarily for testing against Woolmark Standards. The spinning factories normally only tested for basic parameters of count and twist and one of the factories visited had no testing facilities at all.

Mr. Tindall was very well received at all the visits and his advice was sought on many subjects concerned with Worsted processing including choice of raw materials, processing systems, selection of testing equipment, causes of pilling in lambswool garments and machinery innovation i.e. open-end spinning, "Repco" and "CSIRO-spun" systems. Many of the visits generated a new technical link between the Facility and the local companies. Mr. Tindall was

requested to return to a number of the firms visited to offer specific advice on more specialized problems, e.g. maintenance schedules, choice of new plant and effect of processing additives and methods of their application, Mr.Tindall delivered a lecture at the Facility Lecture Theatre on the afternoon of Saturday 25th July,81. A copy of the lecture entitled "Improvement in Worsted Yarn Without Investment" is attached at Annexure IV. As a result of the lecture a number of enquiries were received by the Facility from local spinners seeking advice concerning plant maintenance and yarn quality improvement. The enquiries are being speedly followed up and relevant technical expertise in the form of practical demonstration and "Model" planned maintenance schedules are to be implemented. The Facility Engineer has received comprehensive instruction and data to competently carry out this objective.

3:2) Assessment of the Winding, Twisting and Reeling installation at the Facility.

The material on receipt can pass through various sequences as shown in the accompanying flow diagram(Annexure III)

The specific requirement by the customer and current production lots within the department will determine the path taken. During the period of Mr.Tindall's assignment the majority of yarn for processing was received from the customers in twofold form with a request for dyeing and/or other wet treatments including Shrink resist and Moth proofing. The two fold yarn may pass through the

Schlafhorst Autoconer then to the Croon and Lucke reel or the two fold package may be reeled directly into hank. The material is then dyed in hank, after drying the dyed hanks are backwound on the Mettler hank to cone winder. The material is then returned on cone to the customer. If parties send in two fold yarn for processing there is no opportunity for successful yarn clearing to take place. At best a fault in the two fold yarn can be replaced by a two fold knot, this can be in itself a hazard to satisfactory knitting particularly if the two fold yarn contains many objectionable faults which require removal. Customers sending in single yarn for clearing, twisting, dyeing and back winding have choice of two routes i.e. i) Package dyeing ; Schlafhorst, soft package for dyeing, Hamel two-stage twisting on to finished cone and ii) Hank dyeing, Hirschberger, Volkmann, Croon & Lucke Reeling, hank dyeing and Mettler back winding on to finished cone. The single clearing of the yarn on both the Schlafhorst Autoconer and on the Hirschberger is not satisfactory because of the utilization of mechanical clearers. This subject will be dealt with more in depth in Chapter 6. The Hirschberger Sun-Cheese Winder at present not being equipped with accurate length measurement of packages causes some avoidable waste on the Volkmann twister due to the unequal run out of the "paired" Sun Cheeses. Accurate Length counters are available and should be fitted on this machine. The Facility does not

have means tc apply moisture or additive to yarn. A useful addition to the Mettler Winder is an "add on" device for the purpose of adding "condition" or additive to the yarn being processed.

Other items of equipment which would be beneficial to the yarn Winding, Twisting and Reeling area of the "Facility" are i) a continous package conditioning machine, this consist of a spray device for water (with the addition of the required additive) mounted over a stainless steel conveyer on which the packages are led under the spray. The unit is simple to operate and all that is required is to load the hopper of the equipment with packages for treatment, cones, cheeses cops etc. The " conditioned " yarn is then delivered automatically to a container at the end of the machine ;

and ii) a yarn steamer to set twist/liveliness in yarns on spinning cops, cheeses or cones (This item has in fact been ordered from a local supplier.)

3:3 Provision of Working parameters for waste and invisible losses in Worsted Spinning.

Figures were provided for each processing stage in the current installation and a total figure shown including drawing and spinning as proposed in the Phase II Project Document. Comparable figures are shown for 100% Wool and 100% Acrylic material. Details of estimates/comprehensive waste loss figures are shown at Annexure VIII.

3:4 Formulation of Work Methods

The area of work concerned with this aspect of the assignment was of necessity very sketchy. At this point of time the Facility does not have a staff member with Work Study(Management Services) responsibility. Annexure VII shows how a job is made up of elements. This basic information can be used in the initial stages of allocation of work loads and elementary piece rate calculations should the situation arise at the Facility.

3:5 Quality Control proceedures and interpretation of results

Considering the worsted yarn production sequence from tops to two fold yarn, quality control requirements would be as outlined in Annexure XIV. A practical approach to the requirements of the industry in the Ludhiana district has been taken, many statistical 'control points' can be utilized, but, where the industry is clearly operating more on "rule of thumb" than any

scientific approach the basic elements of Quality Control proceedures with uncomplicated action indication could find more ready acceptance.

3:6 Evaluation of the present yarn clearing equipment fitted to the Winding Installation.

The yarn clearers attached to the Hirschberger and Schlafhorst machines are of the mechanical type. This type of clearer is now regarded as very unsatisfactory in the worsted spinning area and the electronic clearer is now universally applied. The mechanical clearers can in fact increase the yarn hairiness of yarn being cleared if incorrectly set. An electronic yarn clearing installation is a prerequisite to allow present yarn production passing through the Facility to be satisfactorily evaluated. Not only can they be set so precisely that individual fault types e.g. slubs, neps, thick places can be categorized and "offensive" removed and "Inoffensive" left undisturbed but also thin places can be detected and extracted, a fundamental impossibility for a mechanical blade cleared which requires an increase in diameter of the yarn to detect any type of fault. Winding test frames are available where a number of Winding spindles are equipped with the electronic clearers representing the installation. A recording device supplied with the test winder analyses the running yarn accumulating the information from the fault types etc. From the sample test the required clearer settings for the production unit can then be determined. It will be known what

faults are being cleared and what "Inoffensive" faults are being left in the yarn. The settings for the clearers are recorded and it is known that at these settings a satisfactory yarn standard for the processing is achieved.

See accompanying recommendations(Annexure IX) for electronic yarn clearing installation for the Facility as requested by Mr.A.S.Grover.

3:7 Establishment of Yarn Quality Parameters

Yarn quality parameters for yarns expected to be processed through the Facility have been established. Yarn parameters were derived from Uster and IWTO Statistics. These were prepared for 100% Wool and 100% Acrylic and show the expected and outer limit of acceptability for worsted spun yarns in the 16's N.M. to 64's N.M. range. Quality parameters specified include counts tolerances, U%, thin places, thick places and neps. Full tables are shown at Annexure X & XI.

These tables were used in the assessment of the yarn production from several Ludhiana spinning plants shown in Annexure VI.

3:8 Facility inplant Quality Control Proceedures

The currently equipped testing laboratory can carry out a large range of quality control and other tests, comprehensive list is shown at Annexure XII. Quality control testing includes, Uster levelness and Spectogram, tensile strength and elongation, eount, twist, oil content,

moisture content & visual examination by wrap board. However, further testing equipment will be required if all necessary tests are to be performed. This is shown at Annexure XIII.

3:9 Information on test methods for the selection of raw materials concerning Botany Wool, Lambswool, Shetland Wool, Mohair, Acrylic, Cotton, Man-made fibres and their blends.

The following tests would be used to ascertain the type and category of fibre. All the tests mentioned can be carried out on testing equipment currently available in the Facility Testing Laboratory. *The laboratory will be approved by the I.W.T.O. shortly.

TEST FOR.	EQUIPMENT.	TEST METHOD/REFERENCE
FIBRE IDENTIFICATION	PROJECTION MICROSCOPE	FIBRE IDENTIFICATION MANUALS
FIBRE DIAMETER	1) PROJECTION MICROSCOPE	REFERENCE APPROPRIATE
	2) WIRA FIBRE FINENESS METER.	I.W.T.O. OR BRITISH STANDARD TEST METHODS. RELATE RESULT TO WOOL QUALITY OR MAN MADE FIBRE DENIER.
FIBRE LENGTH	WIRA FIBRE DIAGRAM MACHINE	REFERENCE APPORPRIATE I.W.T.O. OR BRITISH STANDARD TEST METHOD. RELATE RESULT TO WOOL QUALITY OR MAN MADE FIBRE PRODUCTION SYSTEM.
CROSS SECTION	ROTARY MICROTONE AND MICROSCOPE EXAMINATION	FIBRE IDENTIFICATION MANUALS.
CHEMICAL ANALYSIS	REQUIRED CHEMICALS REAGENTS ETC.	FIBRE IDENTIFICATION MANUALS.
FIBRE BLEND ANALYSIS	REQUIRED CHEMICALS REAGENTS ETC.	REFERENCE BRITISH STANDARD ETC. FOR TEST PROCEEDURES.

SELECTION OF FIBRES FOR VARIOUS PROCESSING SYSTEMS

The textile spinning industry in Ludhiana has three basic categories, Woollen, Cotton and Worsted Spinning systems. Certain fibre characteristics are pertinent to each system viz.

Woollen System:- The Woollen system in Ludhiana generally applies to "Shoddy" processing which employs reclaimed rags as the raw material. The Woollen system can use virgin fibre as input material and true shetland yarns are produced on this system employing "Shetland" Wools which are quite short, medium to coarse but highly crimped with a soft handle. Shetland yarns produced on the Worsted System are "pseudo" shetland and do not possess the loft and resilience of the woollen system counterpart.

Cotton System: Natural cotton is under 2" in length and therefore the "cotton" system requires fibres of this dimension. The system takes staple, through blow room, carding, draw frames and to spinning. Man-made fibres for this sector would normally be 1.0 to 3.0 denier.

Worsted System: Natural wool fibres used on this system would have a mean fibre length lying between 6 and 8 Cm. with a pronounced bias. Man-made fibres for this sector would normally be in the region of 4.5 to 6 denier. Tops would be prepared by carding staple or in the case of man made fibres e.g. acrylic, polyester, viscose, may be produced on a stretch break machine. Worsted yarn possesses the necessary attributes for apparel and the harder twisted coarser

fibre based products go to weaving for suitings etc., the softer fine qualities including blends containing Lambswool , are twisted with softer "hosiery" twist for use in Knitwear,21 gauge,single bed,rib,and multifeed coarser gauge systems.

4. LOCAL ELECTRICITY SUPPLY

The supply of electricity to the local industry, including the Facility, fluctuates widely in voltage, and power cuts occur daily from several of a few minutes to other single stoppages of up to 8 or 12 Hours. There is no forewarning that a power cut is imminent. Most factories have stand-by generators (including of course the Facility) which can produce a portion of the plant power requirement. The problem is bourne well by industry who consider it is a nuisance but run whatever machinery they can at the expense of air conditioning etc. In textile production this situation leads to product in consistencies which are completely outside the control of technical or management staff.

ANNEXURE I

Title	:UNIDO Expert in Quality Control and Worsted Spinning.
Duration	:Two Months.
Duty Station	:Ludhiana.
Purpose of Project	:To set up a central facility to provide technical services to the knitwear hosiery industry in the state of Punjab.
Duties	:The expert will work in co-operation with the Punjab State Hosiery and Knitwear Development Corporation and is specifically expected to :-

1. Evaluate the quality of worsted spinning in the area and give advice on the technical service requirements.

2. Make a qualitative and functional assessment of the equipment for Worsted Spinning already installed, with special reference to Winding, Twisting and Reeling.

3. Establish norms for working parameters, Waste and invisible losses in Worsted Spinning.

4. Give advice on how to formulate work methods and record the required technical information.

5. Give advice on quality control proceedures, tests and methods for analysing results including recommendations and implementation of corrective measures.

6. Evaluate the clearing installation under the project.

7. Establish quality parameters for yarns which are to be processed and determine the expected improvement compared to the initial yarn quality.

8. Give advice on in-plant quality controls for the Facility.

9. Give advice on the selection and test methods for raw materials e.g. Botany, Lambswool, Shetland, Mohair, Acrylic, Cotton, Man-made fibres and their blends (Yarn production for these fibres and test methods required).

The expert will also be expected to prepare a final report setting out the findings of the mission and recommendations to the Government on further action which might be taken.

VISITS CARRIED OUT TO LOCAL LUDHIANA SPINNING PLANTS. ANNEXURE II

NAME OF COMPANY DATE OF VISIT	BASIC PRODUCTION EQUIPMENT TYPE & AGE. MARKET SUPPLIED.	INTERNAL TESTING AVAILABLE	CONTACTS WITH FACILITY
1. PUNJAB WOOL COMBERS LTD 3.7.1981	Merino and some indigenous wool tops produced. The plant European manufacture. Supply tops to thelocal Worsted Spinners.	Comprehensive atmospherically controlled testing lab. Wool mark Standard capability.	Sought Facility help for technical advice. 25.7.81 Representative of company attended lecture.
2. SWASTIKA WOOLLEN MILLS. 4.7.81	Spinners of yarn in wool and viscose/ Wool blends for government contracts. Very old "Bradford" open drawing and cap spinning equipment. Generally early 1920's equipmet.	Basic testing equipment for counts and twist testing.	Visit arranged for T.C. (JRT) to observe oldest machinery in use for worstedspg.
3. EVEREST WOOLLEN MILLS 4.7.81 *Domestic market supplied.	Hand woven blankets, Cards and Woollen Spinning equipment locally made. Generally 1960's equipment but *some items 1920's.	Basic testing equipment for count & twist testing.	Visit arranged for T.C. (JRT) to observe old Woollen processing equipment.
4. OSWAL WOOLLEN MILLS 6.7.81	Merino wool yarn for knitwear and Acrylic hand-knitting yarn. Some European equipment the remainer locally made Equipment of various ages 1950 to 1965. Wool yarn supplied to Knitters for USSR market. Hand knitting yarn for domestic consumption.	Basic testing equipment for counts & twist testing.	6.7.81. Requests for technical service advice. Slubs in 1/20's NM Wool yarn. 28.7.81 Difficulty processing in spinning shrink Resist treated wool dyed black. 25.7.81 Representative attended lecture

VISITS CARRIED OUT TO LOCAL LUDHIANA SPINNING PLANTS

NAME OF COMPANY DATE OF VISIT.	BASIC PRODUCTION EQUIPMENT TYPE & AGE. MARKET SUPPLIED.	INTERNAL TESTING AVAILABLE.	CONTACTS WITH FACILITY
5. KOHINOOR WOOLLEN MILLS.	Colour mixture and effect yarns in various fibres. Locally made colour blending equipment followed by Bradford open drawing with cap and ring spinning. Equipment produced. mid 1930's.	Basic testing equipment for count and twist testing	25.7.81. Representative of company attended lecture. Visit arranged to show T.C. the unit.
5.7.81	Domestic market supplied.		
6. NAGESH KNITWEAR LTD.	Spin, knit and made up knitwears in wool locally made blending, continental drawing and spinning equipment. Age of equipment around 1955	Comprehensive atmospherically controlled testing laboratory. Woolmark Standard capability.	25.7.81. Representative of company attended lecture. 7.7.81. Request for advice on machinery maintenance requirements.
7.7.81	21 gauge knitwear into Europe(France) Heavier weight garments to USSR.		
7. VARDHMAN SPG. & GENERAL MILLS.	Cotton section - Various yarn including tyre cord production. Equipment local and European. Spinning etc. about 1965	Comprehensive atmospherically controlled testing laboratory.	25.7.81. Representative of company attended lecture.
8.7.81	New Schlafhorst single winders(Electronic clearers) and Volkmann two-for one twisters. Local and export markets. worsted section producing acrylic hand knitting yarn. Equipment locally made, About 1960 Local market for hand knitting yarn.		
8. Ess Ess Sales Corporation (MURARI WOOLLEN MILLS)	Merino Wool Spinning to 2/48's NM and 2/32's NM yarn for Knitwear Production on own hand flats. Locally made continental drawing and Spg. equipment. Product about 1966.	Basic testing equipment for counts & twists.	Visit arranged to show the T.C. a composite spinning & knitting unit
9.7.81	Exports garments to Saudi Arab and Scandanaian.		

VISITS CARRIED OUT OTO LOCAL LUDHIANA SPINNING PLANTS(CONTINUED)

NAME OF COMPANY DATE OF VISIT.	BASIC PRODUCTION EQUIPMENT TYPE & AGE. MARKET SUPPLIED.	MATERIAL TESTING AVAILABLE	CONTACTS WITH FACILITY
9. WADHWA MILITARY STORES. 9.7.1981	Produces Sweaters etc. from dyed yarn which is hand wound on charkas and Underwear from Cotton and Wool blends Very old equipment Produces clothing for Military(Government Contracts)	No testing of any type.	Visit arranged to show T.C. knitting unit producing Jerseys from indigenous Wools.
10. CENTRAL WOOLLEN MILLS 10.7.81	A. 2/32's Nm and 2/48's Nm spin from merino wool. B. 2/32's Nm. from a blend of merino and 20% indigenous wool (58's) Equipment mainly Japanese continental drawing & spinning. Some locally made about 1960. Market for A. local high quality knitwear producers. B. USSR Knitwear market.	Fairly comprehensive testing for counts, twist strength.	25.7.81. Representative of company attended lecture.
11. OSWAL WOOLLEN MILLS(TOP MAKING PLANT) 11.7.81.	Tops in dyed form or White in Wool and cutter converted Acrylic tops produced. Equipment Brand New. Andrea gill boxes being installed. Other equipment mid 1950's generally tops for use within the Oswal Group.	Comprehensive testing in atmospherically controlled testing laboratory.	25.7.81. Representative attended lecture.
12. ANGORA WOOL COMBERS. 14.7.81.	Top making plant being installed in new premises. Equipment. Thibem Cards Schlmberger gill & combs Prince Smith. Equipment made about 1960.	Comprehensive testing lab. will be available with Woolmark testing capability.	Facility staff advising on equipment & layout of lab. 25.7.81. Representative attended lecture.

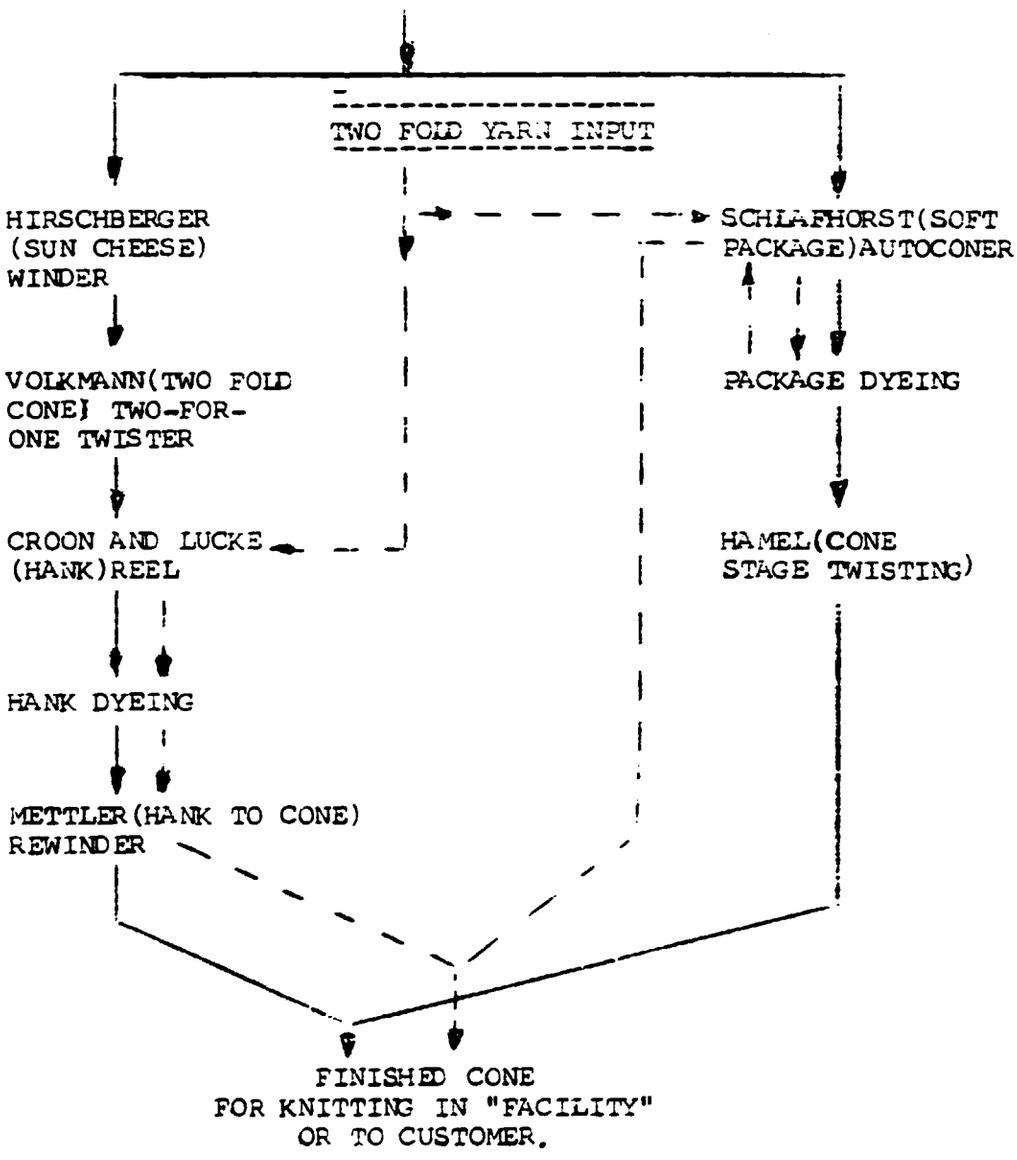
VISITS CARRIED OUT TO LOCAL LUDHIANA SPINNING PLANTS (CONTINUED)

NAME OF COMPANY DATE OF VISIT.	BASIC PRODUCTION EQUIPMENT TYPE & AGE. MARKET SUPPLIED.	INTERNAL TESTING AVAILABLE.	CONTACTS WITH FACILITY.
13. R.N.OSWAL 28.7.81	2/32's Nm yarn for 21 gauge knitwear and 4/16's Nm yarn for hand knitting from merino wool. 4/16's Nm hand knitting yarn from carded acrylic staple. Equipment One line of New Bradford Drawing followed by Uniflex Spinning One line locally produced continental drawing & apron Spg. Equipment about 1960. Market for 2/ 2's Nm. Yarn into knitwear for export. Hand knitting yarn for home market.	Basic testing for counts and twist only.	28.7.81. Facility Staff advising on machinery maintenance. Schedules & yarn quality following a request from the company. 25.7.81 Representative attended lecture.
14. NAGESH HOSIERY EXPORTS. 27.7-81	A) One line 2/32's Nm. in Merino Wool for 21 gauge knitwear. B) One line on approx. 1/5 nm. in Mohair for raised surface garments. A) Equipment locally made continental set followed by apron spinning. B) Old Bradford Open Drawing Set followed by locally made spinning frames with apron drafting. Equipment produced about. A) 1960's B) 1940's Market for 2/32's Nm. is through own knitwear preparation for export. The coarse Mohair Yarn is for the USSR heavy sweater trade.	Basic testing for counts and twist only available.	27.7.81. Facility requested by company to supply maintenance programme & provide information on yarn regularity improvement. 25.7.81. Representative of company attended lecture.

ANNEXURE III

TWISTING, WINDING AND REELING DEPARTMENT

PROCESS FLOW DIAGRAM



ANNEX IV

Improvements in worsted yarn without investment
by J.R. Tindall, Worsted Yarn Spinning Expert and UNDP Consultant

Gentlemen,

Thank you for coming along to this talk this afternoon. It is good of you all to spare the time. I have visited a number of you at your premises and been extremely well received for which I thank you most sincerely. I also appreciate discussing to you that to maintain a position in the highly competitive market in which you carry out your business you have to be very astute and be able to draw on all your experience and background in the area of your particular market.

On the synopsis of the subject matter of my talk, I will be giving you my views on the various topics. Then at the end of the talk we can have an informal discussion when it would be appreciated to have comments and opinions.

As the same of this talk implies, to apply technology does not necessarily mean cash expenditure. All you have to spend initially is TIME.

I think the first topic to be discussed illustrates this point very well:

This is headed Machinery Maintenance and refers to PLANNED MAINTENANCE SCHEDULE which we will talk about later.

Gentlemen, I think we are all guilty of expecting too much from our textile machinery. We run it day and night and in your industry here it is 24 hours in a day for 6 days per week. The machinery is expected to perform satisfactorily all the time and generally the only time a machine will get special attention is when it breaks down. At all other times it is expected to perform satisfactorily with as litte attention as possible. But what happens with all machinery is that it wears gradually. It is only when a break down occurs that this fact is brought home, the component which finally caused the break down may have been malfunctioning for a considerable period before, causing possibly bad yarn and/or inefficient machine performance.

Similarly over a period of time various important settings on the machinery may move outside a tolerable level. Here we would be considering items like the centering the spindles with the rings on a spinning frame on the running position and condition of the aprons in the drafting zone. The positions of the various sliver, roving and yarn guides and abraiding the material and causing waste.

The following yarn faults can occur in your product from a badly maintained spinning frame.

Fault	Cause
1. Irregular yarn	a) Split or deformed drafting apron.
	b) Roving entering draft zone off centre.
	c) Worn bearing giving intermittent or eccentric motion causing irregular drafting.
2. Hairy yarn	a) "Nicked" on badly positioned guides.
	b) Position of spindle not concentric with ring therefore as bobbin fills it touches the traveller and ring.
	c) Badly maintained rings/travellers causing abrasion and tension of the yarn.
3. Spinner's double	a) Distorted dividing plates etc.
	b) Incorrectly set guides.
	c) Blocked or badly set pheumatic under clearers - if fitted.
4. Slubs	a) Mechanical backlash in drafting zone due to lack of lubrication or build up of fly in bearings.
	b) Gross damage to aprons or apron distortion in the drafting zone.
	c) Roving guides to drafting zone very out of centre.
5. Spun-in-fly	a) Material picks up accumulations of fly waste from machine - around worn guides etc. draws it through the drafting zone and spins it into the yarn.

Fault	Cause
6. Distorted and soiled cops	a) Badly maintained builder motions will form distorted bobbins (These may not run successfully at the forthcoming operation).
	b) Cops can be so badly built that they rub against the traveller and ring giving oil/dirt soiling which can be very difficult to remove (Particularly in the final product).

There are many other yarn faults which can be attributed to a mechanical unsatisfactory spinning frame.

How can one ensure that equipment does not deteriorate to such an extent that bad yarn is being produced - undetected?
The answer is PLANNED MAINTENANCE SCHEDULES. Under a plan all equipment in a plant is listed and related work to be done for maintenance listed. It is suggested that on 24 hrs. running for six days per week a plan which ensures planned maintenance of each piece of equipment once every six weeks would be a suitable frequency (See accompanying tabulated layouts (A) and (B). Another term for this type of servicing is "PREVENTIVE MAINTENANCE".

Gentlemen, if you apply this type of maintenance you can save yourselves:

1) Very expensive down-time due to break down.
2) Production of poor quality yarn.

Gentlemen, I should now like to move on to the second topic
CHOICE OF RAW MATERIALS

I intend to keep this section very general because there are so many factors which influence a particular party's choice of raw material. If I may I will base my observations under two specific headings:

i) Fitness for purpose.
ii) Economic view point.

Considering then "Fitness for purpose". This I see as choosing a raw material that is ADEQUATE to satisfy the requirements of the end-user and provides the spinner with a satisfactory production efficiency in the counts and twist being spun.

Of wool qualities available Australian wools would fall into the following categories:

Wool type	Fibre diameter (Microns)	Quality
Super fine	19.5 ± 0.5	70's
Fine	21.4 ± 0.3	64's
Medium fine	24.8 ± 0.7	60's
Cross breeding	27.8 ± 0.7	56's
Carpet wools	32.4 ± 0.8	48's

Indigenous wools are available in small quantities above 58's about 3% between 58's and 54's/56's about 8% and between 54's/56's and 48's quality about 19% of the total production. These wools are rather shorter than imported wools and therefore careful blending is essential to achieve the best product. Once the end use requirements have been established choice of raw material will have been narrowed down to a certain wool quality which has the required characteristics. Then the suitability for processing can be considered with the "Fitness for purpose" approach. The raw material selected is adequate for the purpose but not in any way superior to the requirement. This approach gives the best opportunities for profitability in satisfying the end user with yarn from the most competitively priced tops. The use of man-made fibres in blends with wool can enhance certain properties i.e. spinnability and yarn strength. Polyester and Acrylic are commonly use.

ii) Economic view point

When choosing raw materials for a market which is less demanding and yarn standards are not critical then a different approach can obviously used. One must still have material which will process through the plant very efficiently and this can become the major objective particularly in a highly competitive market. Choice of raw material therefore becomes a case of choosing the cheapest materials to satisfy the production requirements and the end use.

If the end product (garment) is to be knitted multifeed, three or four ends the yarn quality is going to be "MASKED" and obviously does not have to stand up to critical examination in the garments. In this case therefore skillful blending of imported wool and indigenous production can give you the accepted standards of production using the most economically priced raw material.

Thank you Gentlemen, I would now like to proceed with my next "Topic" which is "Methods of drawing and spinning of worsted yarns" (including Auto Leveller Units).

I would like to discuss the Schlumberger drawing and spinning equipment. This company has kept itself in the fore front of innovation as well as establishing a world wide name relating to quality and reliability.

A typical sequence of machines to produce 2/48's Nm yarn from wool would be as follows:

Three drawing stages, one roving stage followed by spinning.

DRAWING

1. GN5 Interesting gillbox with autoleveller. 1 Sliver auto doffing.

2. GN5 Interesting gillbox. 2 Slivers into two cons.

3. GN5 Interesting gillbox. 3 Sliver into three cons.

ROVING

4. FM5N High draft rubbing frame 2 x 20 spindles double ended bobbins.

SPINNING

5. Ring spinning frame type CF 26 90 mm gauge 12 x 440
   Spindles ring diameters 55 mm. Double apron drafting.

Method of operation of a typical mechanical auto levelling device

The autoleveller measures the volume of the incoming material, any variation in input above or below a mean causes the mechanism to alter the draft of the machine. This ensures a constant weight of sliver output. Input variation in weight from + 25% to - 25% of a mean can be accomodated by some autoleveller systems.

Looking at the diagram, an essential part of the device is the memory wheel. This wheel stores the input weight information transmitted to it via the measuring element and the lever system. As the measuring element is situated way back from the drafting elements of the gill box a DELAY is required before a draft charge is made to accomodate a certain change in input weight. The MEMORY-WHEEL provides the correct delay, information put on to the wheel can be used to alter the draft mechanism half a revolution later. Charge of draft occurs operating on back rollers and faller screws.

If the incoming weight goes above or below the percentage limit that can be accommodated the machine is automatically stopped, to await the operatives attention.

DRAWING AND SPINNING PLAN FOR PRODUCING 48's N.M.YARN FROM 100% WOOL

OPERATION.	MACHINE AND MODEL.	INPUT SLIVER WEIGHT GMS/MTR.	DOUBLINGS.	WEIGHT GMS/MTR.	DRAFT.	DELIVERY GMS/MTR.	SPEED MTRS/MINUTE.	NO.OF MACHINES/SPINDLES.	EFFICIENCY%	PRACTICAL OUTPUT KGS./HR.
1	INTERSECTOR GILL BOX MODEL GN5-R	22	10	220	7.8	28	110	1	70	129.5
2	INTERSECTOR GILL BOX MODEL GN5 (2 DELIVERY)	28	5X2	280	10.0	2X14	110	1	70	129.5
3	INTERSECTOR GILL BOX MODEL GN5 (3 DELIVERY)	14	3X4	168	6.2	3X9	110	1	70	124.6
4	HIGH DRAFT RUBBING FRAME MODEL FM 5 N	9	1	9	18	0.5	140	40	70	117.6
5	SPINNING FRAME TYPE CF 34	0.5	SPINDLE SPEED 10,000	DRAFT 24	COUNTS NM 48			12 FRAMES X (440 SPDLS)	90	106.0

NEW METHODS OF SPINNING

Gentlemen, it would be interesting to introduce at this stage the Platt (repco self twist spinner) Known as S.T. Spinning spinner employs a self twist technique to produce a two ply yarn which after a subsequent twisting operation is suitable for weaving into high quality worsted fabrics. The un-twisted S.T. yarn can also be used for certain knitting application. What advantages are claimed for the Repco systems : -

i) Out put speed of 220 metres/minute for all counts.

ii) Productivity of two S.T. spinners approximates' one 240 spindle conventional machine.

iii) For a given production the horse power used is considerably lower than conventional spinning equipment.

iv) Spinning waste is reduced.

v) Direct labour is reduced.

vi) As the spinning take-up cheese is typical of an assembly wound package subsequent twisting costs are less.

The self twist spinner produces yarn without employing spindles, rings or travellers and thus eliminates completely the major limiting factors of conventional spinning. Spinning tension often high on ring frames, is replaced by a much lower controlled winding tension.

Self-twist spinning process:-

Yarn is formed by inserting alternating S /and Z twist on strands of drafted roving emerging from the drafting system. The twist is inserted by passing the strands between two rollers which reciprocate along their axes as they rotate to deliver the yarn a complete cycle of S and Z twist occurs every 22 Cms. Adjacent ends are then run together to form pairs of self twisted yarn. Draft ratios upto 35 are available using built in gear trains. Yarn is taken up on a cheese on the four position machine. The ST yarn may then be twisted either on a ring frame or two-for-one twister. But for certain end uses the ST yarn is quite acceptable. Many firms are selling ST yarn in Wool, Acrylic or various blends to the knitwear industry. The yarn is quite

suitable in most cases for rib structures but is not suitable for single bed as the yarn twist reversal affect shows as a fault on the fabric surface.

The material can be spun and dyed on packages, dyeing on hank is not advisable as the yarn has lower strength and elongation than a conventional yarn.

The system allows for a great deal of flexibility in yarn design, colouration etc. For instance instead of processing from two rovings per "two fold" end four rovings can be used of different blend materials or colours etc.

The system is not suitable for wools below 58's quality and below 2/24's W.C.the yarn becomes unstable in use.

Gentlemen,

Whilst speaking about spinning techniques I would like to mention to you the CSIRO SPUN system. The technique uses a simple principle in the form of a modification to a normal worsted yarn ring spinner to enable two fold yarn to be produced. The principle is to bring together adjacent ends on the spinning machine k the drafted roving strands seperate by an additional roller device attached to the frame and then bring the two ends together to form a "two fold" yarn.

There is a great deal of interest in this technique particularly where very fine counts are being spun.

It is possible to spin finer with a given quality of wool as to all intents and purposes one is producing a yarn of twice the thickness although it is "two fold".

The textile machinery manufacturer Zinser are making the device under licence and producing a frame in corporating the CSIRO spun principles.

Naturally with the yarn being produced being TWO FOLD twists of a level for two fold are used. The production potential of the frame is virtually doubled although of course doffing takes place more frequently and roving inputs also.

PILLING

Thank you, Gentlemen,

I would like now to give you my views on the causes of "Pilling" and possible ways of overcoming the problem.
What is a pill? Pills are small balls of fibre that form on the surface of the fabric. Pilling is due to surface abrasion that rolls and entangles projecting fibre ends and can ultimately work fibres out of the fabric.

Pilling is generally more prevalent in fabrics containing fine wools and is probably the biggest problem in relation to lambs wool in knitwear.

It is inevitable that with short fine fibres in the blend that pilling will occur. Choice of raw material can to some extent reduce the problem. The longer the fibre length, the less prone the fabric becomes to pilling but in practice the raw material may be too expensive for the market and a compromise is selected.

What means are there of reducing the tendency to Pill?

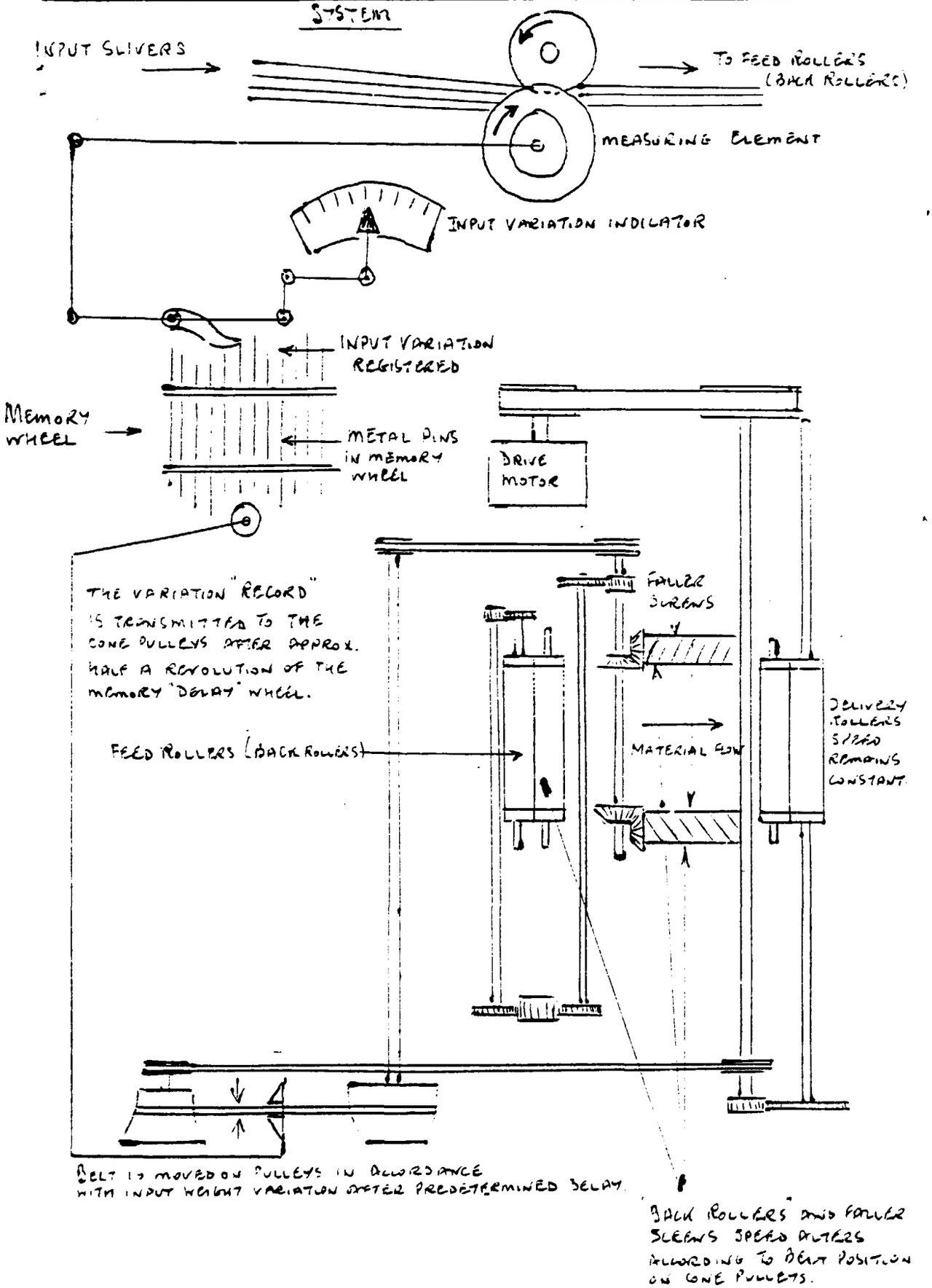
1. Higher twist levels: Whilst appreciating the requirements for soft handle in the "Lambs wool" fabric area the fact that twist levels may be too low can only aggravate the fabrics pilling potential. Increasing single twist will increase the corresponding two fold twist using the normal twist balance procedure to determine the two fold twist. I think these factors contribute to reducing the fabrics tendency to pill but I would suggest that the twist aspect is considered more deeply.

2. Steam setting of yarn: With this technique it is possible to spin the yarn and in twisting increase the level of twist beyond the "balanced" point. The yarn will of course be rather "Lively" and if knitted would give "Spiral" fabric. However, yarn steaming can be utilized. This is a technique using an Autoclave Steamer with programme control.

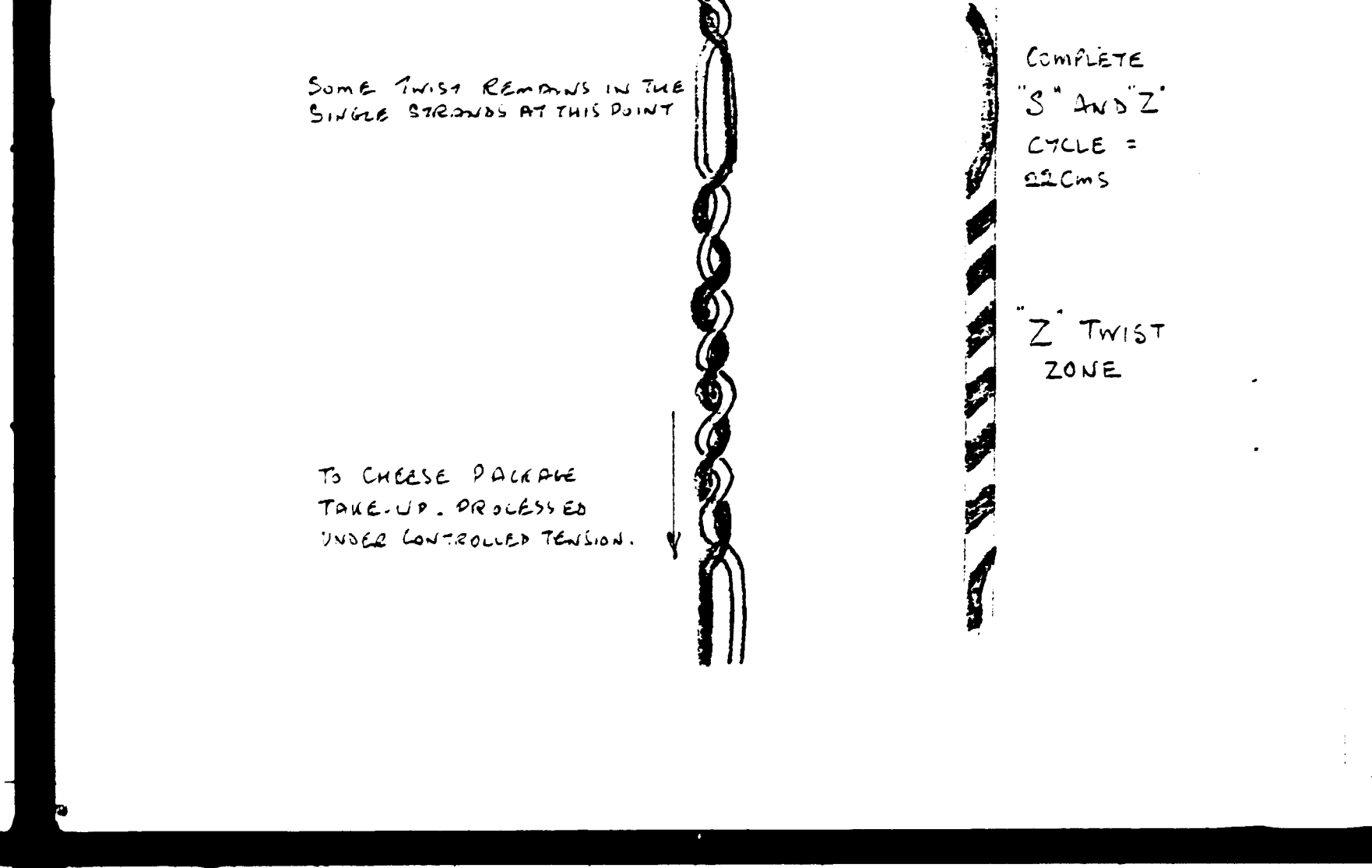
The yarn to be steamed is set on a trolley which can be rolled in and out of the steamer. The cycle would take approximately 20 minutes, made up of evacuation, steaming 95°C for 8 minutes, evacuation and further steaming for 8 minutes at 95°C. After treatment the yarn is allowed to condition and can then be knitted with no fabric spirality occuring. The resultant garment on finishing may be marginally less soft but will have a much higher resistance to "Pilling".

3. Fabric construction: Pills form because fibres slip out of the yarn structure. A firm construction can reduce pilling and a combination of higher twist levels and a firmer construction can, to a large degree, reduce pilling tendency without any appreciable difference to fabric handle.

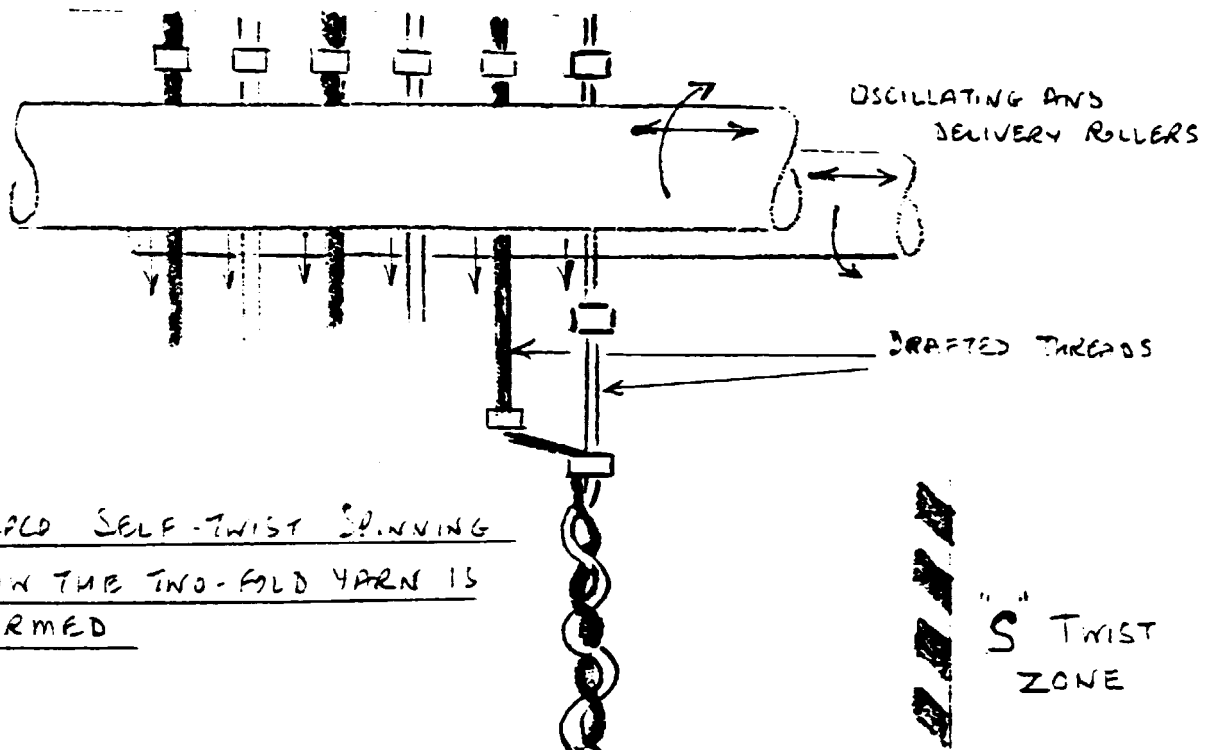
SCHEMATIC DRAWING OF TYPICAL MECHANICAL AUTO-LEVELLING SYSTEM



THUS THE GILL-BOX DRAFT IS ALTERED CONTINUOUSLY TO MAINTAIN A CONSTANT AND REGULAR OUTPUT SLIVER

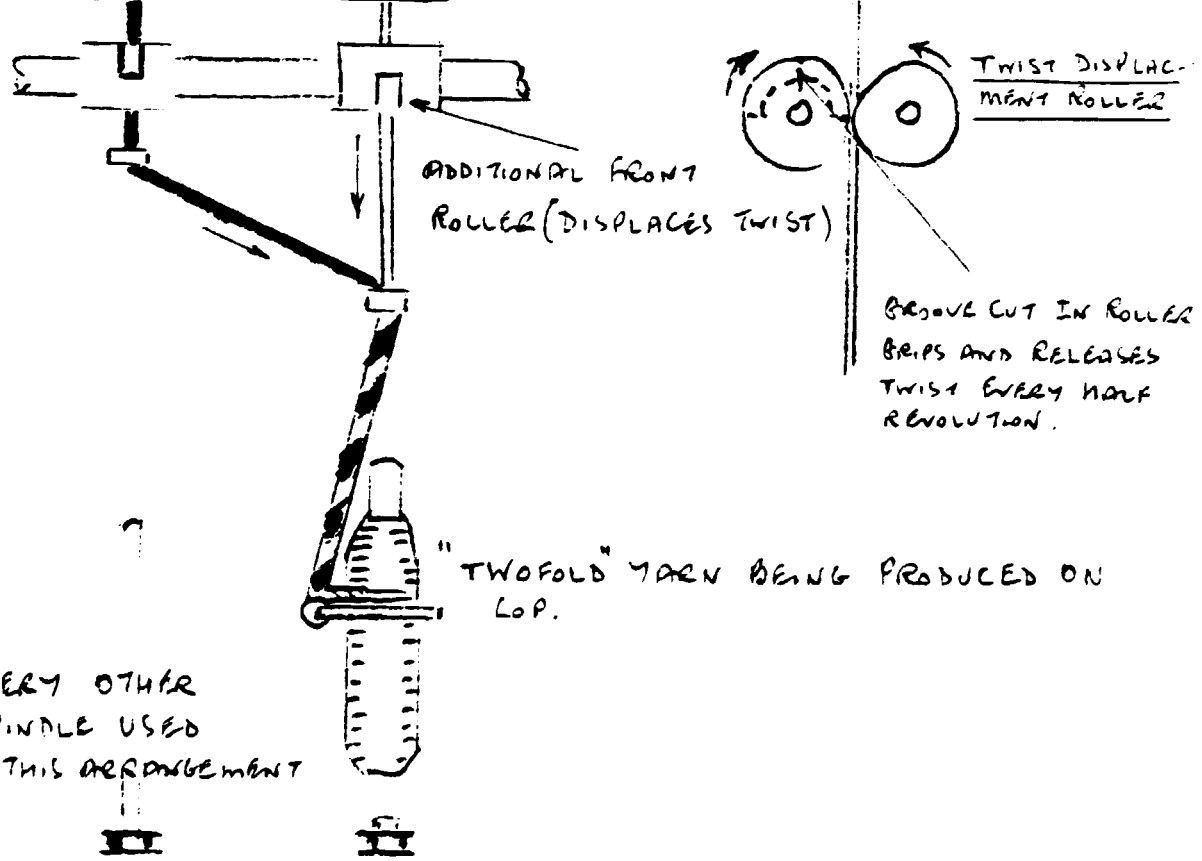

SOME TWIST REMAINS IN THE SINGLE STRANDS AT THIS POINT
TO CHEESE PACKAGE TAKE-UP. PROCESSED UNDER CONTROLLED TENSION.
COMPLETE "S" AND "Z" CYCLE = 22CMS
"Z" TWIST ZONE

DRAFTING UNIT APRON



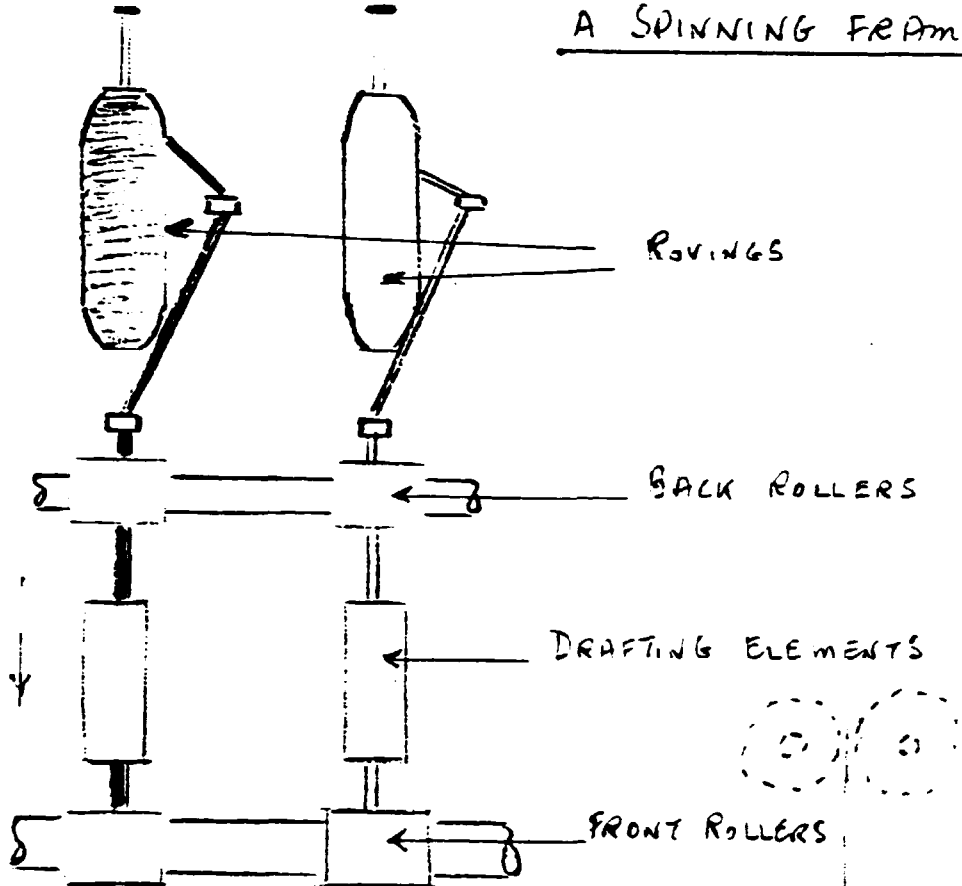
REPCO SELF-TWIST SPINNING

HOW THE TWO-FOLD YARN IS FORMED

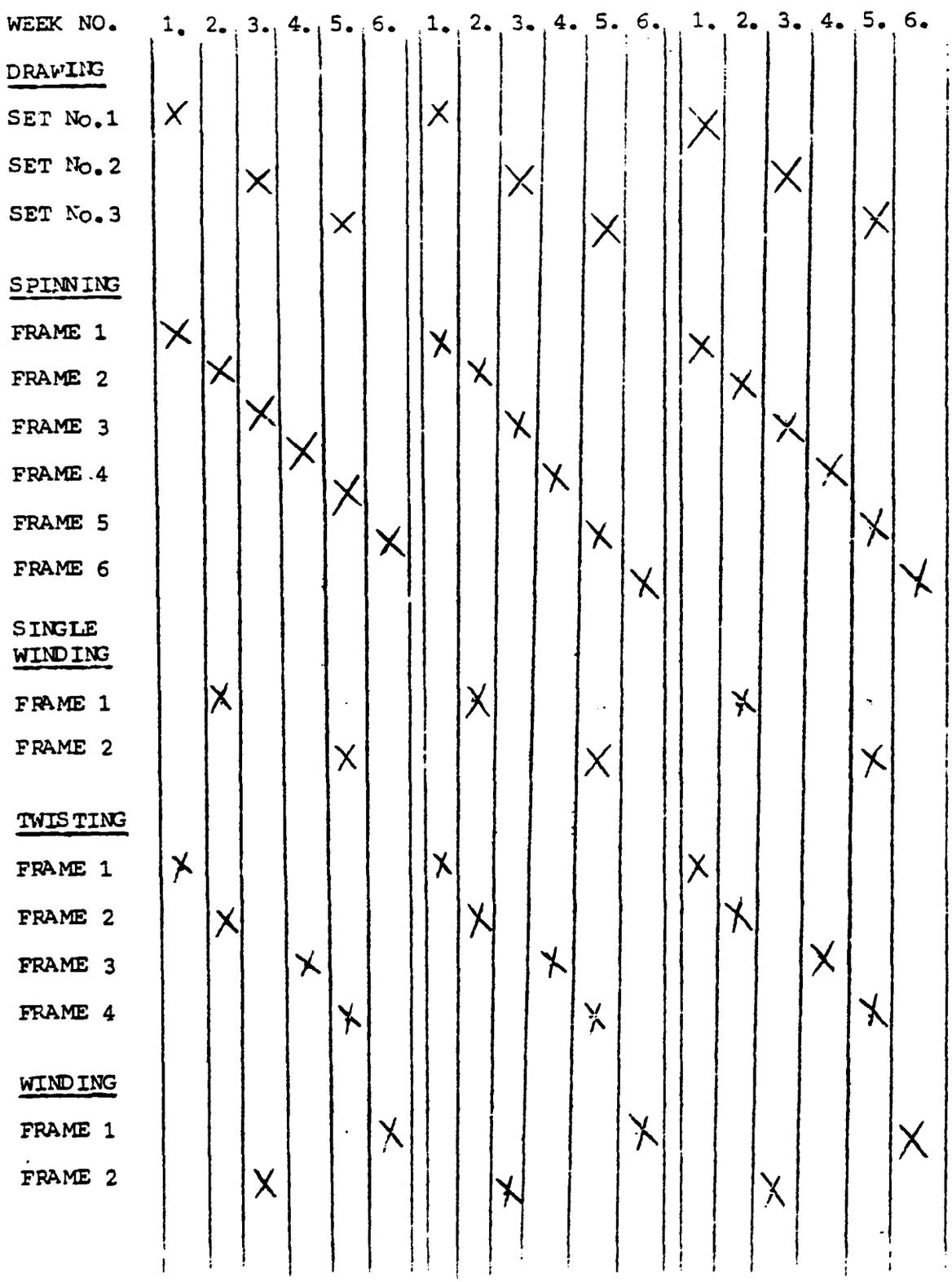

TWIST DISPLACEMENT ROLLER
ADDITIONAL FRONT ROLLER (DISPLACES TWIST)
GROOVE CUT IN ROLLER GRIPS AND RELEASES TWIST EVERY HALF REVOLUTION.
"TWOFOLD" YARN BEING PRODUCED ON LOP.
EVERY OTHER SPINDLE USED IN THIS ARRANGEMENT

NEW METHODS OF SPINNING

"CSIRO-SPUN" TECHNIQUE FOR PRODUCING "TWOFOLD" YARN ON A SPINNING FRAME



(A) PLANNED MAINTENANCE SCHEDULE 6 WEEKLY CYCLE



*MLP

(B)

One maintenance item list for each machine

When Item Complete ✓(Tick Mark)

Machine	Maintenance item list	Date/Sig.
SPINNING FRAME NO.1	Lifter mechanism.	
	Rings -ubrication)	
	Travellers.	
	Top front roller covers.	
	Bottom front roller bearings.	
	Drafting mechanism	
	Aprons - Change as required.	
	Back roller.	
	Guides replace if necessary.	
	Spindles .	
	Centering of Spindles to ring etc.	
	Under clearers (if fitted)	
	Belt tensions and condition.	
	Chain tensions Lubrication etc.	

Synopsis of the Lecture on "Improvement in Worsted Yarn Without Investment" delivered at the Lecture Theatre of the Facility Saturday P.M. 25th July, 81

" It is possible to improve the yarn quality and production efficiency with virtually no investment. The yarn quality is directly related to the condition of production machinery, simple planned maintenance schedules for the machinery can ensure constant yarn quality and will save expensive machine down time.

Proper selection of raw materials to give optimum production through put and end use requirements can relate directly to profitability. The different preparing and spinning sequences for producing Worsted Yarn and merits of auto levelling will be discussed in detail. Suggestions on the main cause of pilling and the means of reducing the problems will also be discussed ".

Attendance at the lecture

Twenty six external company officials attended the lecture.

Firms represented included:

Messrs. O.K.Hosiery Mills.

" Hind Woollen & Hosiery Mills.

" Kohinoor Woollen Mills.

" Greatway(Pvt.)Ltd.

" Nagesh Hosiery.

Messrs. Nagesh Hosiery Exports.

" Sutlej Hosiery Mills.

" Mahavir Spinning Mills.

" R.N.Oswal.

" Adhinath Textiles.

" Vardhman Spinning & General Mills.

" Alps Hosiery.

" Winterland International Knitwear.

" Oswal Woollen Mills.

" O.C.M. (Oriental Carpet Mills).

ANNEXURE V

Assessment of Winding, Twisting and Reeling Equipment installed in the "FACILITY".

Comments regarding each type of equipment are as follows :-

MAKE - SCHLAFHORST AUTOMATIC WINDER.

TYPE - Autoconer 138 - II GKN - X 50 Spindles.

PURPOSE - To prepare soft packages for dyeing.

CURRENT FORMAT - The winder is equipped with an 'S' creel which allows feed packages of single of two-fold yarn on cone.

The winder is equipped with mechanical clearers.

RECOMMENDATIONS - Change a number of creel locations to V type creel to accept spinning cops.

* Re-equip with electronic clearers.

(Both the changes in machine spec.are included in the Phase II document)

MAKE - HIRSCHBERGER WINDING MACHINE.

TYPE - Model NSK, 24 Spindles, Single Sided.

PURPOSE - To prepare sun cheeses for the Volkman two-for-one twister.

CURRENT FORMAT - The Winder is equipped with mechanical clearers. The wound length on a cone is determined by diameter setting.

RECOMMENDATIONS

* Re-equip with electronic clearers.

Fit accurate electronic length measuring counters.

REASONS - Mechanical clearers ve.. inefficient. Measuring length by cone diameter very in-accurate causing considerable waste on the twister. This equipment will cut waste almost totally.

MAKE - METTLER HANK TO CONE WINDER.

TYPE - MODEL 3M - 901. 36 SPINDLES, SINGLE SIDED.

PURPOSE - To rewind dyed hanks on to cone suitable for despatch.

RECOMMENDATIONS - Addition of moisture application device.

REASONS - Addition of moisture to wool yarns, and possibility for application of knitting additives for man-made fibre yarns.

MAKE - HAMEL STAGE TWISTING - ASSEMBLY TWISTING MACHINE.

TYPE - 2/05.3 - 10. 30 SPINDLES DOUBLE SIDED.

PURPOSE - This machine pretwists the yarn dyed on soft packages in preparation for the second s' . twisting.

RECOMMENDATIONS - No changes suggested.

MAKE - VOLKMANN TWO-FOR-ONE TWISTER.

TYPE - MODEL VTS - 07. 66 SPINDLES DOUBLE SIDED.

PURPOSE - To twist on to cone material previously wound on to sun-cheese.

RECOMMENDATIONS - No changes suggested.

MAKE - HAMEL STAGE TWISTING - UPTWISTING MACHINE.

TYPE - 4/2.1.3 - 10. 80 SPINDLES DOUBLE SIDED

PURPOSE - This machine takes the pretwisted dyed yarn and uptwists to produce the final yarn on cone.

RECOMMENDATIONS - No changes suggested.

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* Electronic Clearers - It is suggested that the electronic clearers are backed up by a supplementary yarn fault classifying systems. Possible makers systems were outlined in a note to the Managing Director of PSHC following a request for information. Copy of note is at Annexure IX.

ANNEXURE VI

LOCAL SPINNERS YARN QUALITY ASSESSMENT

The Quality of Worsted yarn production from twelve typical Ludhiana Spinners compared to "Standard" derived from Uster and I.W.T.O. Statistics.

The figures in brackets show the expected figures and the outer limits of acceptability.

No. of Spinner.	Quality.	Nominal Counts N.M.	Counts N.M. as tested.	U %	Thin Places -50%	Thick Places + 50%	Neps +200%	Acceptable = A. Not Acceptable= NA.	Comments.
1	Acrylic	28's N.M.	26.16 (27.30-28.70)	21.01 (12.6-16.1)	208 (33-310)	604 (16-103)	0 (12-95)	N.A.	High Uster figures and as excessive number of thick places.
2	Wool	30's N.M.	30.23 (29.25-30-75)	16.42 (15.2-17.2)	247 (125-400)	172 (62-275)	130 (20-74)	A.	Considered acceptable.
3	Wool	32's N.M.	Not available.	19.83	1212	556	112	N.A.	Outside tolerance in all aspects.
4	Wool	32's N.M.	31.98	17.47	416	130	90	N.A.	Uster and nep figures high.
5	Wool	32's N.M.	29.35	15.75	88	128	174	A.	Considered acceptable.
6.	Wool	32's N.M.	27.70	19.61	417	85	78	N.A.	Uster figure too high.
7	Wool	32's N.M.	34.58	18.32	98	28	23	N.A.	Uster figure too high.
8	Wool	32's N.M.	29.84	19.41	320	40	250	N.A.	Uster figure too high.
9	Wool	32's N.M.	29.01 (31.20-32.80)	18.96 (15.3-17.2)	252 (135-420)	452 (64-180)	164 (21-75)	N.A.	Uster figure high, excessive thick places.
10	Wool	40's N.M.	44.05 (39.00-41.00)	16.29 (15.7-17.5)	504 (200-500)	150 (78-197)	195 (23-82)	A.	Considered acceptable.
11	Wool	48's N.M.	44.92	22.44	1332	562	140	N.A.	Outside tolerance in all aspects.
12	Wool	48's N.M.	44.56 (46.80-49.20)	27.39 (15.9-17.8)	3650 (250-580)	1820 (80-215)	4380 (24-84)	N.A.	Outside tolerance in all aspects.

Discussion:- The quality of yarn from nine out of the twelve spinners falls outside the acceptable level. The quality from the other three could be considered acceptable. The principle reasons for the poor quality, were the badly maintained equipment, in-sufficient Quality Control in plant and to some extent the raw material choice which is selected against a background of commercial competitiveness rather than quality competitiveness.

ANNEXURE VII

WORK STUDY

BASIC UNITS

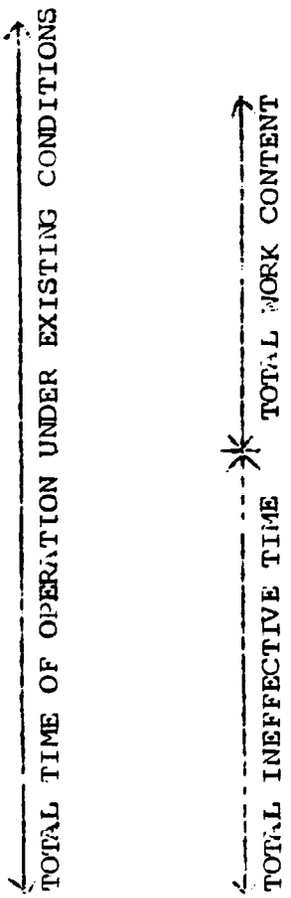
HOW THE TOTAL TIME OF A JOB IS MADE UP

MAN-HOUR - THE LABOUR OF ONE MAN FOR ONE HOUR.

MACHINE-HOUR - THE RUNNING OF A MACHINE OR PIECE OF PLANT FOR ONE HOUR.

THE TIME TAKEN BY A MAN OR A MACHINE TO CARRY OUT AN OPERATION OR PRODUCE A GIVEN QUANTITY OF PRODUCT MAY BE CONSIDERED MADE UP IN THE FOLLOWING MANNER : -

HOW MANUFACTURING TIME IS MADE UP:-



	BASIC WORK CONTENT OF PRODUCT AND/OR OPERATION
A	WORK CONTENT ADDED PRODUCT INEFFICIENCES
B	WORK CONTENT ADDED MACHINE INEFFICIENCES
C	INEFFECTIVE TIME INCORRECT UTILIZATION OF LABOUR (MANAGEMENT CONTROL)
D	INEFFECTIVE TIME INCORRECT METHODS BY OPERATIVES. (OPERATIVE CONTROL)

ANNEXURE VIII

Percentage Waste and invisible loss expected when processing i) Wool and ii) Acrylic in the count range 2/16's N.M. to 2/44's N.M. through the facility's equipments assuming that drawing and spinning equipment will be added to the processing route for Phase - II

i) 100% Wool.

Hank dyed route			Soft package dyed route.		
Process	% Waste.	% Invisible loss.	Process.	% Waste.	% Invisible loss.
DRAWING	2.0	1.0	DRAWING	2.0	1.0
SPINNING	1.5	0.25	SPINNING	1.5	0.25
HIRSCHBERGER SUN CHEESE WINDING	1.5	0.25	SCHLAFHORST WINDER(SOFT PACKAGE)	1.5	0.25
VOLKMANN TWO FOR ONE TWISTER	0.75	0.25	DYEING (+DRYING)	0	2.50
CROONE AND LUCKE REEL-HANK.	0.75	0.50	PRETWISTING ON HANEL-BOBBIN	0.75	0.50
DYEING (+DRYING)	0	2.00	UPTWISTING ON HANEL-CONE	0.25	0.25
REWIND HANK TO CONE ON METTLER	1.0	0			
TOTAL %	7.50	4.25		6.00	4.75

ii) 100% Acrylic.

Hank dyed route.			Soft package dyed route.		
Process.	% Wasted	% Invisible loss.	Process.	% Waste.	% Invisible loss.
DRAWING	1.5	0.1	DRAWING	1.5	0.1
SPINNING	1.0	0.1	SPINNING	1.0	0.1
HIRSCHBERGER SUN CHEESE WINDING	1.0	0.2	SCHLAFHORST WINDER(SOFT PACKAGE)	1.0	0.2
VOLKMANN TWO FOR ONE TWISTER.	0.5	0.2	DYEING (+ DRYING)	0	0.2
CROONE AND LUCKE REEL-HANK.	0.5	0.2	PRETWISTING ON HANEL-BOBBIN.	.5	0.2
DYEING (+DRYING)	0	0.2	UPTWISTING ON HANEL-CONE.	.25	0.2
REWIND HANK TO CONE ON METTLER.	1.0	0.2			
TOTAL %	5.50	1.20		4.25	1.00

WASTE = ACCOUNTABLE WASTE. INVISIBLE LOSS = LOSS OF MOISTURE FROM THE MATERIAL AND UNACCOUNTABLE "FLY" WASTE ETC.

ANNEXURE IX

Dated : 28th July'81.

Specifications for electronic yarn clearers on the Schlafhorst Auto-Coner and the Hirschburger Sun Cheese Winder

The following types of electronic clearers are suitable for the yarn processing expected through the Facility.

Types of electronic . yarn clearers available

1. Leopfe.
2. Peyer.
3. Uster

Type of fault sensing head

1. Loepfe - Optical/electronic.
2. Peyer - Optical/electronic.
3. Uster - Capacitance.

Supplementary yarn fault classification equipment

1. Peyer - Digitex/Digimat.
2. Uster - Classimat.
3. Leopfe - Laboratory - LDN - Adjuster (not as comprehensive as 1 + 2)

Recommendations

Option 1 :- An Uster electronic yarn clearing installation and the Uster classimat fault classification equipment would be recommended for the following reasons :-

1. Uster are recognised International leaders in the development and application of electronic clearers.
2. The equipment has simplified setting features, and is known to be very stable under all conditions.
3. Service back-up good - normally.

4. Classimat standards are specified by many European Knitwear manufacturers.

5. Without modification, the Uster electronic clearers can be linked to the Uster data collection devices, Uster Activity Recorder and the Uster Cone data Recorder.

Installation requirements

50 Spindle Schlafhorst Autoconer Model 138

50 Uster Automatic yarn clearers(including provision for thin place detection. Type UAM/D MK 20(Range 5.0 Nm to 125 Nm)

5 Uster Automatic control units type SLMT. Each section of ~~ten~~ spindles on the Schlafhorst can be set for a different yarn type.

24 Spindle Hirschberger Sun Cheese Winder Type NSK

24 Uster Automatic yarn clearers(including provision for thin place detection) Type UAM/D MK 20 (Range 5.0 N.M. to 125 N.M.)

2 Uster Automatic Control Units type SLMT. Each section of 12 spindles can be set for a different yarn type.

Classimat equipment

I Classimat II yarn classification installation including I six end test sample winder. The classimat installation would normally be situated in the Quality Control department of the plant, or suitably situated in the winding department.

Option 2:-

as an alternative to the Uster Automatic Clearer Installation a Peyer installation could be considered.

Installation requirements

50 Spindles Schlafhorst Autoconer Model 138

50 Peyer opto-electronic clearers type PI-12(including provision for thin place detection). This clearer will accommodate the count range expected through the Facility.

5 Peyer control Units type S.G.(Each section of ten spindles on the Schlafhorst can be set for a different yarn type).

24 Spindle Hirschberger Sun Cheese Winder Type NSK

24 Peyer opto-electronic clearers type PI-12(including provision for thin place detection).

2 Peyer Control Units type S.G.(Each section of twelve spindles on the Hirschberger Winder can be set for a different yarn type.)

Digitex/Digimat equipment

1 Digitex/Digimat yarn classification equipment suitable for the above installation.

The Digitex/Digimat equipment is carried on a portable trolley. It can be linked into any of the Peyer clearer sensing heads to obtain relevant information. It does not have a test winding frame in the Quality Control department as with the Uster classimat equipment.

N.B. Potential suppliers of equipment should be made aware of the local problems of large voltage fluctuations and wide range of Relative Humidity and temperature which occur in the processing area.

ANNEXURE X

Yarn test parameters derived from Uster and IWTO Statistics. (1) 100% Wool Yarns.

Nominal Count Metric.	Count tolerance 2½% ± N.M. (Test at correct condition)	Expected U %	Thin Places per 1000 metres. (-50%)	Thick Places per 1000 Metres (+50%)	Neps per 1000 metres (+200%)
16	15.6 - 16.4	14.2 - 16.4	50 - 210	35 - 120	17 - 60
18	17.55 - 18.45	14.3 - 16.6	55 - 250	40 - 135	17 - 61
20	19.50 - 20.50	14.4 - 16.8	65 - 285	45 - 150	18 - 62
22	21.45 - 22.55	14.7 - 16.9	68 - 300	47 - 154	18 - 63
24	23.40 - 24.60	14.8 - 17.0	7[illegible] - 315	50 - 156	19 - 65
26	25.35 - 26.65	15.0 - 17.0	75 - 350	53. - 158	19 - 68
28	27.30 - 28.70	15.1 - 17.1	100 - 375	58 - 168	19 - 71
30	29.25 - 30.75	15.2 - 17.2	125 - 400	62 - 175	20 - 74
32	31.20 - 32.80	15.3 - 17.2	135 - 420	64 - 180	21 - 75
34	33.15 - 34.85	15.4 - 17.3	145 - 440	67 - 185	22 - 76
36	35.10 - 36.90	15.5 - 17.4	160 - 460	70 - 190	22 - 79
38	37.05 - 38.95	15.6 - 17.5	180 - 480	74 - 194	22 - 81
40	39.00 - 41.00	15.7 - 17.5	200 - 500	78 - 197	23 - 82
42	40.95 - 43.05	15.7 - 17.5	210 - 520	80 - 200	23 - 82
44	42.90 - 45.1	15.8 - 17.6	215 - 540	82 - 205	24 - 83
46	44.85 - 47.15	15.9 - 17.7	235 - 560	85 - 210	24 - 83
48	46.80 - 49.20	15.9 - 17.8	250 - 580	88 - 215	24 - 84
50	48.75 - 51.25	16.0 - 17.9	275 - 600	90 - 220	25 - 85
52	50.70 - 53.30	16.1 - 18.0	280 - 610	94 - 225	25 - 86
54	52.65 - 55.35	16.1 - 18.0	290 - 620	98 - 230	25 - 87
56	54.60 - 57.40	16.2 - 18.1	310 - 630	100 - 234	25 - 88
58	56.55 - 59.45	16.2 - 18.1	325 - 640	102 - 238	26 - 90
60	58.50 - 61.50	16.3 - 18.1	350 - 650	105 - 240	26 - 91
62	60.45 - 63.55	16.4 - 18.1	375 - 720	115 - 245	26 - 91
64	62.40 - 65.60	16.5 - 18.2	400 - 780	125 - 250	27 - 92

ANNEXURE XI

Yarn test parameters derived from Uster and IWTO Statistics.(2) 100% Acrylic Yarns.

Nominal Count Metric.	Count tolerance 2½% N.M. (As tested in Lab. Atmosphere: 65%±2% RH 20 ±2°C Temp.	Expected U %.	Thin Places per 1000 Mtrs. (- 50%)	Thick Places per 1000 Metres (+ 50 %)	Neps per 1000 metres(+ 200%)
16	15.6 - 16.4	11.4 - 15.7	23 - 309	12 - 99	9 - 72
18	17.55 - 18.45	11.7 - 15.8	24 - 309	13 - 100	10 - 74
20	19.50 - 20.50	12.0 - 15.8	25 - 309	13 - 100	10 - 80
22	21.45 - 22.53	12.2 - 15.9	27 - 309	14 - 101	10 - 83
24	23.40 - 24.60	12.3 - 15.9	29 - 309	14 - 101	11 -- 86
26	25.43 - 26.65	12.4 - 16.0	30 - 310	15 - 102	11 - 90
28	27.30 - 28.70	12.6 - 16.1	33 - 310	16 - 103	12 - 95
30	29.25 - 30.75	12.7 - 16.2	35 - 310	17 - 104	13 - 100
32	31.20 - 32.80	12.8 - 16.2	37 - 310	18 - 111	13 - 105
34	33.15 - 34.85	12.9 - 16.3	39 - 310	18 - 115	14 - 110
36	35.19 - 36.90	13.0 - 16.3	41 - 311	19 - 120	14 - 115
38	37.05 - 38.95	13.1 - 16.4	43 - 311	19 - 123	15 - 125
40	39.00 - 41.00	13.2 - 16.5	45 - 311	20 - 125	16 - 130
42	40.95 - 43.05	13.3 - 16.5	47 - 311	21 - 126	16 - 133
44	42.90 - 45.10	13.3 - 16.6	50 - 311	22 - 128	17 - 136
46	44.85 - 47.15	13.4 - 16.6	52 - 312	23 - 130	17 - 140
48	46.80 - 49.20	13.5 - 16.6	55 - 312	24 - 132	18 - 145
50	48.75 - 51.25	13.6 - 16.7	58 - 312	25 - 134	19 - 150
52	50.70 - 53.30	13.6 - 16.7	61 - 312	25 - 136	19 - 153
54	52.65 - 55.35	13.7 - 16.7	63 - 312	26 - 138	20 - 158
56	54.60 - 57.40	13.8 - 16.8	65 - 313	26 - 140	21 - 162
58	56.55 - 59.45	13.9 - 16.8	67 - 313	27 - 141	21 - 169
60	58.50 - 61.50	14.0 - 16.8	68 - 313	27 - 142	22 - 175
62	60.45 - 63.55	14.1 - 16.9	70 - 313	28 - 143	22 - 176
64	62.40 - 65.60	14.2 - 16.9	72 - 313	28 - 144	23 - 178

ANNEXURE XII

FACILITY INTERNAL QUALITY CONTROL TESTS

PARAMETER TO BE CHECKED.	SINGLES YARN ON RECEIPT.	SINGLE YARN AFTER CLEARING.	CLEARED AND DYED SINGLES YARN ON CONE.	CLEARED & DYED DOUBLED YARN IN HANK.	GREY DOUBLED YARN FROM CUSTOMER FOR DYEING.
1. VISUAL ASSESSMENT (YARN BOARD)	SWATCHES ARE KNITTED. ABNORMALITIES REPORTED TO CUSTOMER & WRITTEN INSTRUCTIONS SOUGHT.	SWATCHES ARE KNITTED AND CHECKED.	X	X	X
2. USTER TESTING.	✓	✓	X	✓	X
3. TENSILE STRENGTH & ELONGATION.	✓	X	X	✓	X
4. COUNT	✓	X	X	X	X
5. TWIST	✓	X	X	✓	X
6. YARN DIAMETER	✓	X	X	X	X
7. OIL CONTENT	✓	X	✓	✓	✓
8. MOISTURE REGAIN	✓	X	✓	✓	✓
9. COLOUR FASTNESS TO LIGHT	X	X	✓	✓	✓
10. COLOUR FASTNESS TO RUBBING.	X	X	✓	✓	✓
11. COLOUR FASTNESS TO WATER.	X	X	✓	✓	✓
12. COLOUR FASTNESS TO DRY CLEANING	X	X	✓	✓	✓
13. COLOUR FASTNESS TO PERSPIRATION	X	X	✓	✓	✓
14. COLOUR FASTNESS TO WASHING.	X	X	✓	✓	✓
15. RELAXATION & FELTING SHRINKAGE.	X	X	✓	✓	✓
16. VISUAL APPRAISAL OF THE KNITTED SWATCH OF FINISHED MATERIAL	X	X	✓	✓	✓

ANNEXURE XIII

Items required for Quality Control Laboratory(proposed for Phase II) *Additional

No.	Name and detail of equipment.	Quantity required.	Suppliers' name and address
1.	Portable moisture tester with balance (Metric Scale) Ref.No.97-A.	1	Messrs.James H.Heal & Co.Ltd. Richmond Works, Halifax, West Yorkshire HX 3 6 EP U.K.
2.	Moisture Testing Oven Ref.No.80 with Metric Weights and one spare can.	1	------ " ------
3.	Martindale Wear and Abraision Tester Ref.No.103 with lever press sample preparation equipment.	1	------ " ------
4.	Pilling Tester. Ref.No.116/2DP	1	------ " -------
5.	W.I.R.A.Rapid oil extraction apparatus Simplified Version for occasional usage.	1	Messrs.Thorn Automatic Ltd., Beech Avenue, New Basford, Nottingham NGT 7JJ (U.K.)
6.	W.I.R.A.Single Fibre Strength Meter with recorder.	1	------- " --------
7.	W.I.R.A.Friction Tester with Motorized Winding drum.	1	W.I.R.A.Hendinglay Lane, Leeds IS6 1 BW(U.K.)
*8.	W.I.R.A.Fibre Length(medium to long fibre) TESTER	1	------ " ---------
*9.	Shirley yarn Hairiness Meter.	1	Shirley Developments Ltd., P.O.Box 6, 856 Wilmslow Road, Didshery, Manchester M20 85A U.K.

ANNEXURE XIV

QUALITY CONTROL PROCEEDURES
AND INTERPRETATION OF RESULTS.

Equipment required for testing of tops to finished yarn, interpretation of results and action for corrective measures.

Tests generally apply to both wool and man-made fibres items differing are noted : -

(A prerequisite being that all equipment is situated and all tests carried out in a controlled atmosphere of 65 ± 2% RH 20°C ± 2°C

PARAMETER UNDER TEST.	EQUIPMENT.	CONTROL STANDARD.	ACTUAL RESULT	ACTION IF OUTSIDE TOLERANCE
1. FIBRE LENGTH	WIRA FIBRE DIAGRAM M/C	STATED M.F.L. FOR QUALITY	M.F.L. LONGER IR SHORTER THAN STATED	REFER TO TOP SUPPLIER
2. FIBRE DIAMTER	PROJECTION MICROSCOPE OR AIRFLOW METHOD	STATED FOR QUALITY OR MMF DENIER	GREATER OR SMALLER THAN STATED OR DENIER	REFER TO TOP SUPPLIER
3. CONDITION (NOT GENERALLY APPLIED TOMM.M.F.)	MOISTURE TESTING OVEN.	ALLOWED MOISTURE CONTENT FOR MATERIAL	ABOVE OR BELOW ALLOWED FIGURE	ADJUST WEIGHT OF MATERIAL.
4. OIL CONTENT (WOOL ONLY)	SOXHLET APPARATUS OR RAPID OIL EXTRACTION APPARATUS	ALLOWABLE STANDARD FOR MATERIAL.	ABOVE OR BELOW ALLOWED FIGURE	REFER TO TOP SUPPLIER
5. SLIVER WEIGHT	BENCH MEASURE AND BALANCE	ESTABLISH INTERNAL STANDARDS*	ABOVE OR BELOW STANDARD FIGURE	ADJUST FEED TO FIRST DRAWING PASSAGE.
6. SLIVER REGULARITY (OCCURENCE OF PERIODIC FAULTS)	USTER LEVELNESS TESTER AND SPECTOGRAM.	ESTABLISH INTERNAL STANDARDS*	OUTSIDE ESTABLISHED STANDARDS.	REFER TO TOP SUPPLIER

Tests 1-6 Refer to tops received from external supplier.

Test 7 -13 Refer to drawing, spinning, twisting etc.

PARAMETER UNDER TEST.	EQUIPMENT.	CONTROL STANDARD	ACTUAL RESULT.	ACTION IF OUTSIDE TOLERANCE
7. WEIGHT PER UNIT LENGTH.	BENCH MEASURE AND BALANCE.	ESTABLISH INTERNAL STANDARD*	ABOVE OR BELOW STANDARD	ADJUST MACHINE DRAFT ACCORDINGLY
8. SLIVER LEVELNESS OCCURENCE OF PERIODIC FAULTS.	USTER LEVELNESS TESTER AND SPECTOGRAM.	ESTABLISH INTERNAL STANDARD*.	ABOVE STANDARD.	CHECK MACHINE SETTING AND RETEST UNTIL WITHIN STANDARD
9. YARN LEVELNESS (OCCURENCE OF PERIODIC FAULTS.	USTER LEVELNESS TESTER AND SPECTOGRAM AND IMPERFECTION INDICATOR.	ESTABLISH INTERNAL STANDARD USING USTER STATISTICS AS GUIDELINE	ABOVE STANDARD.	CHECK MACHINE SETTINGS AND RETEST UNTIL WITH IN STANDARD.
10. TWIST OF SINGLE YARN.	SINGLE YARN TWIST TESTER.	INTERNAL CALCULATED FIGURE FOR GIVEN COUNTS	MEAN ABOVE OR BELOW CALCULATED	CHANGE TWIST CHANGE WHEEL ON SPINNER TO OBTAIN CORRECT RESULT.
11. COUNT OF YARN (FOR WOOL AT CORRECT CONDITION)	COUNTS REEL COUNTS BALANCE.	TOLERANCE OF +2½% ALLOWED.	MEAN ABOVE OR BELOW TOLERANCE	CHANGE SRG. FRAME DRAFT CHANGE WHEEL UNTIL CORRECT.
12. TWIST IN FOLDED YARN.	TWO FOLD YARN TWIST TESTER	INTERNAL CALCULATED FIGURE FOR GIVE COUNTS	MEAN ABOVE OR BELOW CALCULATED.	CHANGE TWIST CHANGE WHEEL ON TWISTER TO OBTAIN CORRECT RESULT.
13. FAULT CLASSIFICATION.	USTER CLASSIMAT PEYER DIGITEX/ DIGIMAT SYSTEM	INTERNAL STANDARDS OR CUSTOMER SPECIFIED STANDARDS.	RESULT NOT ON STANDARD	REFER TO CLEARING INSTALLATION SETTINGS.

(Continued)....

* ESTABLISHMENT OF INTERNAL STANDARDS

These are meaningful average figures which can be established for the accepted quality level of a product or process. This figure then becomes the "Standard" on which to base the Quality Control levels.

INTERPRETATION OF USTER LEVELNESS RESULTS AND SPECTOGRAPH TRACES

U% Uster Levelness statistics are accepted by I.W.T.O.as providing excellent figures on which to base quality control norms. Spectograph trace indicates any fault in the material being analysed which is occuring in a periodic fashion. A periodic fault can usually be traced to some mechanical component in the process malfunctioning on a regular time or distance basis. This may be an eccentric roller or sticking bearing. By examining the trace closely by linking the drafts used in the process and the machine roller diameters etc. the offending item can be traced.