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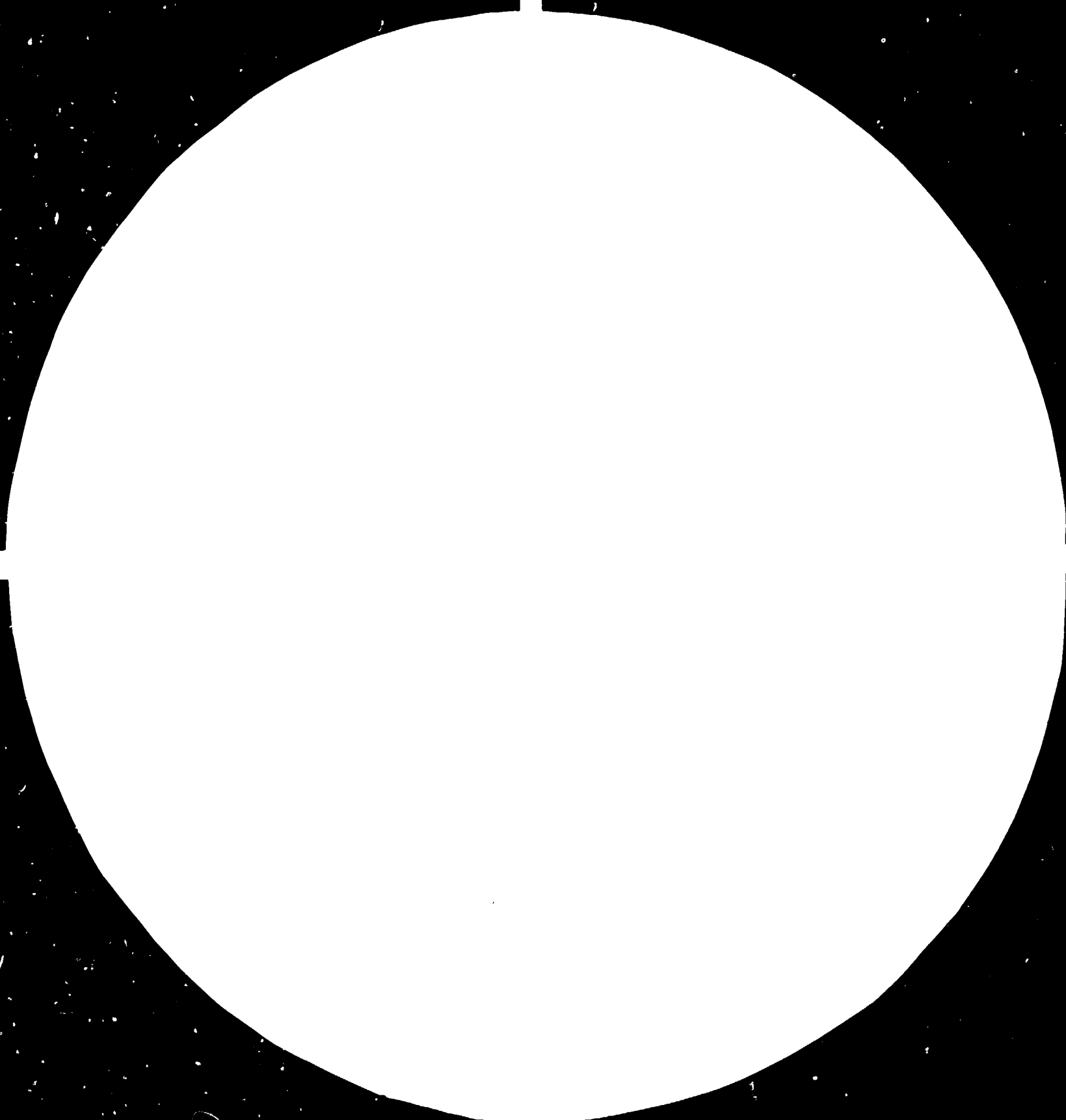

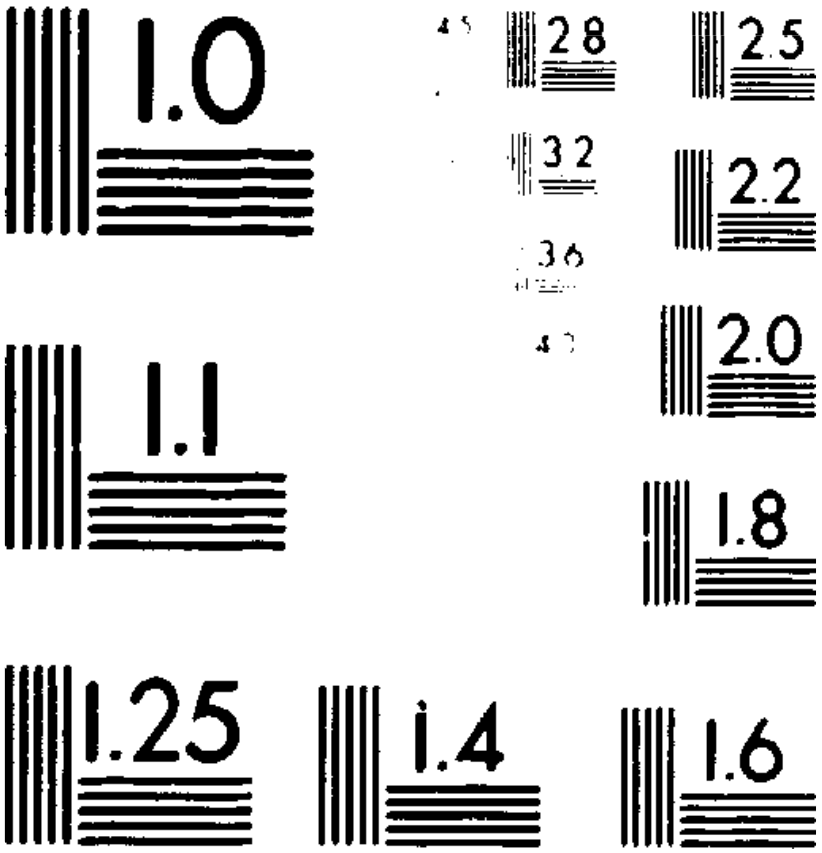

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CENTRAL TESTING LABORATORIES FOR JUTE GOODS
DHAKA, BANGLADESH
DP/BGD/79/030

BANGLADESH

Technical report: Setting-up of Quality Control Measures and Establishment of Testing Laboratories (2nd mission)*

Prepared for the Government of the
People's Republic of Bangladesh
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of E.J. Gordon,
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United Nations Industrial Development Organization
Vienna

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I. INTRODUCTION

This report refers to the work of the expert on quality control who completed his second short mission of two months duration. The first short mission lasting three months was undertaken during July, August and September of 1983.

The project which was originally conceived in 1979 commenced in September 1982 when the project adviser took up his post and is scheduled to continue with extensions until March 1985. The project is concerned with an export certification scheme to be run by the Directorate of Inspection for Jute Goods under the Ministry and involves the setting up of three laboratories which can subject these goods to tests which will assess their conformity to specifications suitable for export.

The project consultant in his first report made reference to a previous project BGD/73/043 (S.L. LEANG) which was concerned with quality control methods and which was financed by UNIDO.

The first report contained three recommendations one of which was not accepted by the Director for the Inspection of Jute Goods and as explained in the report no attempt was made to persuade his acceptance of it. The second was concerned with establishing a series of standard descriptions of cloth faults in an attempt to remove variations between inspectors and the consultant included proposals on how this might be done along with a number of tentative descriptions. No further work has been done on this recommendation as the Deputy Director who would have been involved left the service of the Directorate and his post has not yet been filled.

The last recommendation was concerned with standard test methods and it is in the implementation of this that the expert was engaged during the current mission.

A. Abstract

Project DP/BGD/79/030

Purpose:

To assist the Directorate of Inspection for Jute Goods, under the Ministry of Jute, to set up quality control measures, to operate quality control equipment in testing laboratories, and to establish appropriate standard procedures for issuing Export Inspection Certificates.

The Mission was of two months duration to :

1. Recommend quality control methods and standards for test operations in the laboratories;

2. Recommend a channel for technical communication between central testing laboratories and the manufacturing industries;

3. Prepare instructions for process control methods to be used as a guide to quality control measures;

4. Develop systems for the standardization of jute goods.

In the previous mission the state of the laboratories precluded work being done on the main purpose of the project. In this mission however it was possible to undertake training of the laboratory personnel in standard procedures of testing which would be followed when certifying goods as being worthy of export. The recommendations include references to practising and extending these methods to the laboratory assistants who have not yet been appointed.

B. Explanatory notes

During the period of the assignment the exchange rate was on average T 24.85 = $ 1.

In the text of this report reference is made to both metric and British units and the local units have been converted into one or other. The industry uses a mixture of the two systems and the government is moving towards the introduction of metrication.

The units which require definition are :

X Lb/sp - Yarn count; X = weight in lb of 1 spyndle (14,400 yds)

X Tex - Yarn count; X = weight in grammes of 1000m.

Q.R. - Quality Ratio expressed as a percentage; $\frac{\text{lbf X 100}}{\text{lb/sp}}$

CBC - Carpet Backing Cloth

QC - Quality Control

1 Ton - 2240 lb; 1000 kg.

CV% - $\frac{\text{SD X 100}}{\text{mean}}$

Hessian - Plain weave jute fabric with single warp

Sacking - Twill jute fabric with double warp

CRT - Constant rate of traverse

CRL - Constant rate of loading

CRE - Constant rate of extension

lbf - pound force

kgf - kilogram force

LINRA - Linen Industry Research Association

WIRA - Woollen Industry Research Association

BDS - Bangladesh

ASTM - American Society for Testing Materials

K_p - Warp cover

K_t - Weft cover

kP - Kilo pascal

SD - Standard Deviation

BS - British Standard

MR - Moisture Regain

PICK - One Weft Thread

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II. RECOMMENDATIONS

The recommendations made in this section arise from the training programme undertaken by the expert in conjunction with the Chief Technical Adviser.

1. A member of staff who is senior in rank to the other members of staff at the laboratory should be appointed to supervise the work both inside and outside the laboratory. This senior member of staff will be available at the laboratory to sign the export certificates, deal with cases which are extra-ordinary and make contact with senior members of the management staff of the mills when required. He should be a person who is familiar with the technical side of manufacture and be conversant with the testing equipment and methods used in the laboratory and understands the inter-relationship between manufacturing and testing.

2. The Assistant Directors who have undergone fellowship training in the UK in the use of the testing instruments and machines should continue with a series of experiments in their own laboratories to commission the instruments, gain expertise in using them and to familiarise themselves with the techniques of handling jute and other materials to be tested.

3. The Assistant Directors should prepare a training programme along the lines of that conducted by the expert and Chief Technical Adviser during the second mission of the former and use it to train the personnel who will work in the laboratories.

4. As the laboratories would be inoperative until the personnel is trained immediate steps should be taken by the Directorate to employ suitable persons and start this training.

5. All the instruments in the laboratory should be run and a full range of tests be carried out at least once every six months, or more frequently during the monsoon season, to keep the instruments in working order and the personnel familiar with the test methods.

6. Records of these check tests should be maintained for reference and analysis.

7. As the distances to be covered by the inspectors between mills and the laboratory are in many cases quite long, the Directorate should consider supplying each laboratory with a simple means of transport such as a light motorcycle to be used selectively by the inspectors. The decisions regarding use could be taken by the senior member of staff referred to in recommendation 1.

8. The inspectors should be supplied with steel tapes and portable measurement devices to enable them to check the mill dimensions for certification purposes. These tapes and devices would require to be calibrated from time to time and their accuracy would require to be o.5% for length and correct to the nearest 5 mm for width.

9. As many different carpet structures as possible should be analysed and tested to build up a bank of knowledge of the performance of carpets when subjected to the laboratory tests. No criteria exist for judging the performance of jute carpets and should it be necessary to set specification limits to their performance this knowledge would be invaluable. If possible the yarns used in the manufacture of carpets, particularly the pile yarn, should be tested in an attempt to relate carpet performance to yarn properties.

10. As the Assistant Directors will be making judgements on small samples extracted from large deliveries in many cases, they should understand the statistics involved. It is likely that they may be called upon to draw up specifications based on existing or new types of yarn and cloth and some knowledge of statistics beyond that normally required for quality control is highly desirable. Ranking and correlation would be useful in subjective testing and testing of the significance of the mean would be of value in setting specification limits.

In addition to these recommendations the project adviser has made a number of proposals regarding the introduction of the scheme to industry. These suggestions are endorsed by the expert and some of the proposals are inherent in the recommendations made by him in this report. The expert is conscious that much of the implementation of the recommendations will place an additional burden on the project adviser and in this respect UNIDO might consider some sort of follow-up programme which would allow for a person familiar with the technical details of the project to check and correct any deviations from the agreed test methods and procedures. This follow-up might take the form of a short service commission when the scheme has been introduced to the industry.

III. THE JUTE INDUSTRY

A. RAW MATERIALS AND COSTS

The crop for 1983 amounted to 5.35 million bales of which at 30th June 1984 0.5 million bales remained as a carryover until the new crop reached the market. The new crop begins to arrive on the market about July and continues over the subsequent three months. This year the country experienced very heavy rains early in the year which caused a great deal of flooding and much of the jute crop was affected by being immersed during the maturing period. This will undoubtedly reduce the crop and tentative forecasts put this as substantially below 5.0 million bales and the prices being discussed are in the region of $52 per 100 kg for White jute and $60 per 100 kg for Tossa. This compared with the average price quoted in the statistics for 30th June of $ 32 per 100 kg. In the experts previous report the average price was $ 24 per 100 kg and was not expected to drop lower when the bulk of the crop came on the market. In fact the price continued to rise irspite of the reasonable size of the crop.

B. STATE OF TRADE

The production of hessian shows a small increase over the previous two years and although the stock has risen this is unlikely to cause any difficulty in view of the likelihood of reduced supplies of raw jute. Sacking generally is down in production but as the market was very sluggish last year it is likely that some mills switched to hessian while CBC shows a slight increase over the previous year and a drop in stock. There is evidence that the price of CBC is lower than the profitable level. Yarn and twine mills appear to have increased their production but the carpet manufacturing section is still operating at a modest level and while the other sections send the bulk of their production overseas the carpet section managed to export 40% only of the production and stocks rose by 17%.

IV. THE LABORATORIES

When the writer arrived in Dhaka none of the laboratories was ready to be put into operation. The one at Demra near Dhaka had a temporary supply of electricity which allowed for lighting but no power and the water pump which draws water from the tube well was not in working order as the electric motor had been affected by flood water entering the pump house.

At Khulna the public electricity authority had not connected the laboratory to the public supply because of a dispute over the payment of a bill by the building contractor. The lack of the supply not only made the working of the instruments impossible but there was no power to drive the water pump to fill the storage cistern from which the laboratory sinks are supplied.

At the Chittagong laboratory the public services were unable to connect the laboratory to the public water supply and negotiations were underway to sink a tube well. Although the single phase electrical supply was connected and some of the instruments were capable of being used the water pump required three phase supply and this would have to wait for a supplementary connection to the power supply.

As the Demra laboratory appeared to be the most likely one to be completed it was arranged that training would take place there and a deadline was set for 12th July 1984 for supply of electricity and repair of the water pump motor. In fact the electrician worked late on the 12th and the Assistant Director in charge of the laboratory phoned the Project Adviser in the evening to say that power was now

available, although still on a temporary line, it was adequate to supply all the single phase equipment. The air conditioners for the standard conditions room had not been delivered and these are the only pieces of equipment which would require three phase supply.

On the first working day after the supply of power it was discovered that the internal wiring had a number of faults which required to be put right and so too did some of the instruments.

The laboratory at Khulna eventually had power connected on 25th July but as arrangements had been made to do the training in Demra it was considered unnecessary for the expert to spend time commissioning a second set of instruments and this was left for the adviser to do after the expert had returned to U.K.

V. THE TRAINING SESSIONS

During the early part of the mission when power was not available at the laboratories the expert took the opportunity in collaboration with the adviser to prepare some instruction material for the Assistant Directors concentrating on those tests which were most likely to be used frequently. The list of tests which were taught by the adviser and expert in conjunction and the instruction material prepared by the expert are included in the appendix to this report.

As the Assistant Directors will be in charge of the laboratories and will be required to train their laboratory assistants it was considered appropriate to have them as the first group for training. No appointments of laboratory staff have been made and there was therefore no real alternative to this plan. An additional factor was the absence through resignation of the Deputy Director who would supervise the technical work of the Directorate. The expert adopted a method of job breakdown to carry out the instruction as it served the immediate purpose of instruction and would also be a training model for the Assistant Directors when they come to pass on the instruction to their own personnel.

The pattern of instruction comprised (a) an explanation of the underlying principle of the test, (b) the purpose which it serves in assessing the jute and other material, (c) a demonstration of the method used and (d) practise of the method by the Assistant Directors under supervision. Although some of the sections (a) and (b) might have been unnecessary in view of the study fellowships undertaken by these gentlemen during the latter part of 1983 it was found that although they appeared to know how to operate many of the instruments the Assistant Directors were unaware of the principle involved and terms such as CRT, CRL and CRE which are common knowledge among those regularly engaged in textile testing were unfamiliar terms to them as were many other terms.

It was clear too that they lacked skill in handling the equipment and the materials which were under test and this made the instruction rather protracted. It had to be impressed on them that they were being taught a uniform standard method for each test and individual deviations from the method are not permitted. Any changes which might be introduced in the future had to be made in all three locations simultaneously and with the agreement of all three. The lack of the technical Deputy was a particularly handicap in making this point as it is considered that he would be the arbiter of any differences which might arise between one laboratory and another. It is imperative therefore that a sound technical person be appointed as soon as possible and certainly well before the departure of the adviser to ensure that the appointee is made familiar with the standard test methods.

The programme was further protracted by frequent power cuts and by fluctuations in the voltage of the power supply which on occasions was measured as low as 170v for what should be a 220v supply. The Instron Tester developed a fault and the training on this instrument had to be abandoned. Many of these troubles were occasioned by the extreme delay in the supply of electricity to the laboratory which rendered it impossible for the project adviser to have the instruments fully commissioned before the start of the experts mission.

The training programme was spread over two sessions with the Assistant Directors being given a break between the two to allow for some assimilation and enable them to return to their respective laboratories to check on the progress of work. The break allowed the adviser and expert to prepare more instruction material and commission the instruments to be used. The opportunity was taken to have the technician make some small pieces of equipment such as templates and gauges which it was found would be useful when the laboratories become operational. Most testing laboratories have these aids and accept them as common place.

A few of the tests which the laboratories are capable of doing were not covered either because the equipment was inoperative or not available or the time was too short. The adviser is aware of these tests and will make good the omissions.

Time did not allow for checking the performance of one person against another to gauge the correlation in all cases. In yarn testing for count however this was possible and using the same equipment with similar material all three showed a reasonable correlation one with another. In carrying out a similar check on fabric testing the poor correlation was found on investigation to be due to a deviation from the standard method by one of the Assistant Directors. This was a fortuitous exemplar which reinforced the instruction on standard methods.

The training sessions were exhausting but not exhaustive as explained earlier and the expert acknowledges the cooperation and help of the adviser during the sessions and realises that he will require to continue to add to and reinforce the instruction already given. In this respect the adviser has drawn up a programme of laboratory exercises which the Assistant Directors can follow as soon as the laboratories at Khulna and Chittagong are commissioned. He will supervise those exercises and check the correlation between the results from each of the three centres.

VI. CONCLUSIONS

The expert would have preferred to have spent some time at the Khulna and Chittagong laboratories to help commission the instruments but as the state of the laboratories and the shortness of time did not allow this to happen the work will have to be done by the Assistant Directors under the supervision of the project adviser. The Assistant Directors of these two laboratories have the advantage of experiencing some of the difficulties met during the commissioning of the Dhaka establishment and the technician staff is well aware of the action taken there to correct the faults.

Calibration will require to be carried out by the technician staff at least until some organisation exists in Bangladesh whereby external calibration can be done.

The instruction and support material is included with this report as an appendix for reference purposes and may be retained by the Directorate as a record of the methods used. The Assistant Directors were given copies of the material during the instruction periods and should make use of them when practising the test methods and giving instruction to the staff of each laboratory.

ANNEX - 1

THE TRAINING SESSIONS

The list of tests undertaken by the adviser and expert during the short service mission.

Linear density of yarns from packages.
Twist in yarns from packages and fabric.
Strength and extension of yarns from packages.
Friction of yarn against steel.
Crimp of yarns from fabrics.
Linear density of yarns from fabrics.
Methods of selecting and cutting fabric samples.
Width and length of woven fabrics.
Strength of woven fabrics - fringed strips test.
Strength of woven fabrics - grab test.
Counting of threads per unit length.
Mass per square area of woven fabrics.
Tear strength of woven fabrics (wing rip test).
Reconstruction of woven fabrics from test analysis.
Counting of stitches per unit length.
Strength of seams - "T" test.
Bursting strength of fabrics.
Air permeability.
Analysis of carpet structures.
Sampling and cutting of carpet specimens.
Abrasion resistance of pile fabrics.
Carpet thickness test.
Static loading and recovery of pile fabrics.
Dynamic loading and recovery of pile fabrics.
Measurement of pile height and length.
Tuft withdrawal tension measurement.

Testing of fastness to light of dyed materials.

The crocking test for fastness of dyestuffs to wet and dry rubbing.

Moisture content tests - Drying oven.

WIRA rapid oven.

Dean and Stark equipment.

Aquaboy moisture tester and probes.

Oil content of yarns and fabrics by Soxhlet and WIRA rapid method.

Testing stability of emulsions by acid separation and centrifuging

Viscosity of oil.

Salinity of water.

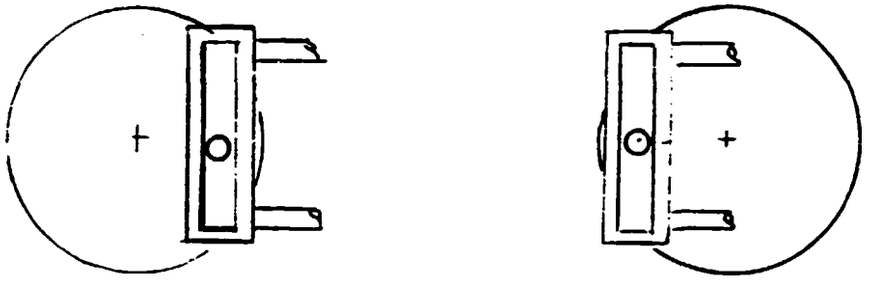
pH and its measurement.

Starch analysis by refractometer.

Yarn Testing for linear density (count)

Reeling of test hanks

The laboratory reel is 90 inches in circumference and as the meter indicates in yards the reel will make 40 revolutions for each set of 6 test lengths. To prevent the yarn from piling there is a traverse motion driven from the reel through the stud on a disc engaging with a slot on the traverse bar. As there is a dwell at each end of the traverse some piling of the yarn will occur and in order to standardise any slight effect that this might have on the test the reel will be started with the stud in the centre of its vertical traverse as shown.



i.e. with the guide bar at one extremity or the other of its traverse.

If 100 yd hanks are reeled the guide bar will complete one half traverse for each set of 6 samples and no adjustment of the stud will be necessary.

If six packages are available for the test they can be reeled simultaneously by placing them on the package holder or if too large on the floor. The ends are led through the ceramic guides, under the tension bar, through the twixxle guides and are attached to the reel by the spring clips. The handle should be in the lowest position and the spring clips will be level with the guide bar. Set the counter to zero and turn the handle at a steady rate of about 80 turns per minute to prevent lashing of the yarn as it balloons off the package. When 40 revolutions have been reached the reel is stopped with the handle in the bottom position again. The ends are cut below the spring clips and the hanks removed by cutting each one in such a way that the ends overlap to ensure that the first and last coils are complete.

JOB BREAKDOWN

	Step	Key Point
1	Check machine is set to zero	Stud in correct position.
2	Place six packages on the package holder (or floor).	All unwind in the same direction. To give uniform twist disturbance.
3	Draw off some yarn from each package, drop into ceramic guide, pass under tension bar, insert into twist guide and insert into spring clip.	Pass once round clip and pull.
4	Operate cancelling lever on counter.	
5	Turn handle 40 times.	Finish in bottom position.
6	Cut each hank from the reel.	Hold yarn from spool below clip and cut between.
7	Coil and knot each hank.	
8	Clear pieces of yarn from clips.	

Yarn Testing for Linear Density (Count)

Weighing

As the weighing is required to an accuracy of 0.2% it is suggested that the Oertling top pan weighing instrument be used. This instrument has two scales.
(a) 600 grammes and reads to 0.01
(b) 6000 grammes and reads to 0.10

For most of the yarn samples the lower scale will be adequate as 100 yds of jute warp will weigh about 24 grammes and heavy sacking weft will not exceed 170 grammes. The instrument is very sensitive to air currents and the reading will be affected thereby. For this reason the balance should be screened from drafts preferably by placing it in a glass fronted box with a hinged lid to allow access for samples.

Weighing is done by first checking that the scale is set to zero when unloaded and placing the measured hank on the pan. Allow the instrument to settle and read the scale. If the scale is fluctuating take the mid point reading.

The instrument requires time to warm up and 30 minutes is recommended as an allowance before any readings are taken. The instrument may be left on for long periods and it is recommended that it be switched on at the start of each working day and switched off at the end.

JOB BREAKDOWN

Step	Key Point
1. Check that instrument has been set to zero.	
2. Place sample on weigh pan.	Place gently.
3. Read mass in grammes from scale.	Allow instrument to settle. Record on test sheet.

Yarn Testing On Goodbrand Single Thread Tester

STRENGTH TESTS - PREPARING MACHINE

The machine must be set to the dimensions required by the test specification. These are normally the length of yarn to be tested or the distance between the grips and the speed of traverse of the lower grip. In addition the correct range must be set on the machine to give a scale reading which lies above the lower 10% of the scale but below the top 10%. The scale may be chosen by referring to the yarn count in lb/spindle and the force required to break the yarn will lie between 0.75 and 1.2 times the count in lbs. depending upon the quality.

E.G. 8 (lb/sp) x 1.0 (warp quality) = 8 lbf = 3.57 kgf

The range required for this yarn would therefore be 0 to 6 kg and as the QR may vary between the limits indicated the mean results could lie between 3.57 x 0.75 = 2.68 and 3.57 x 1.2 = 4.29 which are within the range of the selected scale.

The test length may be varied by moving the lower grip on the scale to an appropriate position. This is done by unscrewing the locking pin situated beneath the lower grip, removing it, sliding the grip along the scale to the desired length and relocating the locking pin in the hole in the scale. The machine is made with locating holes spaced at 5 cm intervals between 15 cm and 60 cm. If a specification requires a length which is different to that which coincides with a hole in the scale another hole may be drilled or arrangements made with the buyer that the nearest length may be used.

The length between grips is important as the test results will be artificially high if a shorter length is used and vice versa.

The speed of traverse of the lower grip is designed to break the yarn at about 20 seconds from commencement of the traverse and with a fixed speed machine this should occur about the centre of the scale. With jute yarns which are relatively inextensible the grip and pendulum traverse will have a constant relationship i.e. pendulum traverse is proportional to grip traverse. The traverse must be smooth and not vary by more than 5% during the test. If the traverse speed fluctuates breaks will occur at a lower load than normal because of the acceleration during any period of increase.

In the Goodbrand single thread tester the end of the yarn at the top grip is passed round in an anticlockwise direction while at the lower grip it is passed round in a clockwise direction. This ensures that the yarn follows a vertical path tangential to the drum on which the pendulum is mounted.

The breaking extension of jute yarn is very low and is rarely asked for in a specification. If required it is best obtained by using an autographic recorder which can be fitted to the Goodbrand machine. The pen on the recorder traces a line on the chart which can be related to the vertical or load scale and to the horizontal or extension scale. The load scale at maximum is equal to the maximum deflection of the machine scale hence on the 0 to 6 kg scale the maximum is 6 kg while on the 0 to 30 kg scale it is 30 kg and intermediate values are proportional. The drive to the recorder drum has a fixed ratio and the ruling on the chart will be a measure of the difference between the distance moved by the lower grip and the distance moved by the upper grip.

Yarn Testing On Goodbrand Single Thread Tester

STRENGTH TESTS - INSERTING YARN

Job Breakdown

The machine should be set for the specified speed of traverse length and with the motor running.

Step	Key Point
1. Place yarn package on the floor adjacent to the machine.	
2. Pull off length of yarn from outside of package and cut.	About 10 yds (m) Waste yarn into receptacle.
3. Holding end of yarn to prevent loss of twist pass it round the grooved part of the upper grip twice (in anti-clockwise direction). Pass through slot to grip and tighten hand screw. Trim end.	Hold the upper grip while inserting yarn & tightening Left hand thread.
4. Draw yarn from spool and pass roung grooved part of the lower grip in clockwise direction twice, pass through slot to grip and tighten hand screw. Trim end.	Apply sufficient tension to make yarn straight but not enough to displace pendulum arm.
The instrument is now ready to be operated. 5. Turn lever to engage clutch and break yarn.	
6. Reset lower grip.	
7. Note reading on quadrant scale. Reset to zero.	Record on test sheet.
8. Loosen upper hand screw and remove yarn.	Left hand thread.
9. Loosen lower hand screw and remove yarn.	Put in receptacle.
10. Repeat steps 2 to 10 for as many test lengths as required from 1 spool.	

TWIST TESTING

The checking of twist may be done against a specification by untwisting samples of yarn and counting the number of turns required to remove all the twist from a known length of the sample. This is done using the twist tester which has one clamp adjustable for length up to 250mm (10 inches) and another in a rotary chuck which can be driven in either direction to remove the twist. Care must be exercised when doing the test to ensure that no twist is lost or disturbed by running the yarn between the fingers or false results will be obtained.

The test length is selected by pulling off a length of yarn from the package and inserting the yarn into the clamp in the chuck. The yarn from the package can then be placed into the fixed clamp and the clamp tightened. As jute is relatively inextensible the need for a fixed tension is not so great as with highly extensible yarns. If the specification requires it however the constant tension device can be used by clipping the yarn to the tension slide before securing it in the fixed clamp. The mass of the weights available are 2g, 5g, 10g and 21g. The latter is the carrier on which the weights hang.

To untwist the yarn turn the handle and rotate the chuck in the appropriate direction. There are two revolution counters, one for each direction of twist. To check that all the twist has been removed a mounted needle may be used to run between the fibres or from one clamp to the other.

The tension weights can also be used to measure the uptake due to twist. That is the loss in length occasioned by the insertion of twist which in the case of single hessian yarns is small but with ply yarns is greater. To find this uptake a length of yarn is extended beyond the fixed clamp and attached to the tension device. As the twist is removed the fixed clamp will be drawn along the slide and the uptake may be read off on the black scale. If single yarn is used the reading will only be valid if a fibre reaches from one clamp to the other. If no fibre present in the length of yarn is capable of doing this the yarn will be pulled apart and the test will be void.

JOB BREAKDOWN

Step	Key Point
1. Place yarn package adjacent to twist tester.	Direction of unwinding.
2. Pull off some yarn and clamp yarn.	Rotating clamp.
3. Insert yarn into fixed clamp.	Do not run through fingers tension lightly.
4. Zero the counters.	
5. Turn handle.	Correct direction.
6. Check that twist is all removed.	Use mounted needle care that yarn is not broken.
7. Take reading.	Note direction of twist. Record on test sheet.

FABRIC STRENGTH - FRINGED STRIPS

The load required to break a strip of fabric is used as a measure of fabric quality and while there are other properties which might be examined the strength is an overall measure of yarn strength, number of threads per unit distance and regularity of weaving process. The strips are cut parallel to the warp or weft and to ensure that the threads run continuously throughout the strip a fringe is made by pulling threads out at each side. This fringe should contain sufficient threads to allow for any slight bias which is present in the fabric. With most plain weave fabrics it is possible to run the marker along a thread of warp or weft when marking off the strips and this ensures that the strips are cut parallel.

When inserting the strips into the grips of the testing machine it is difficult to tension the fabric equally across the width of the strip. To make sure that tension is even a broad clip may be used to hold the fabric instead of pulling it by hand. This method can be used on the Goodbrand machines but the design of the Instron grips prevents its application.

Specifications usually quote the length of the strip as that length which is under stress in the testing machine. To this must be added sufficient length to allow for grips and for the operator to handle it outside the grips. For the Goodbrand machines the minimum length would be the test length plus 5 inches and for an 8 inches test length the cut length would be 13 inches. The Instron machine has pairs of grips which are 3 inches across the face and 2 inches deep or 2 inches across the grips and 1 inch deep. A similar allowance can therefore be made.

If the specification suggests a method of selecting the tests lengths from the piece of fabric the method should be adopted. It is recommended that fabric within 2 inches of the selvedge be excluded as there is occasionally crowding of threads on the warp. Similarly obvious cloth faults should be avoided. Selecting warp samples which are adjacent to one another across the width will ensure that the same threads are not tested in each strip. With weft however they should be spaced out along the length to sample different weft packages if possible. Where modern looms which draw the weft from large spools or cones this is unlikely.

Some extension will occur at the start of each test as the yarn crimp is removed by the load applied and if the crimp value is high the strip may narrow in the centre. This is not a problem in most jute fabrics which will be met with. The removal of crimp however does affect the test particularly if the traverse rate is high. In the Goodbrand machines the traversing grip will move during the extension part of the test but the pendulum will remain almost stationary until the crimp is removed. It will then make a rapid movement and if the rupture occurs during this rapid movement an overthrow will result.

If the fabric is not held properly in the gripe it may slip and be torn instead of broken. In this case the breaking load will be lower than that expected and should should not be used. If the strips are retained in the order in which they are broken an examination of any abnormally low results may show evidence of slipping in the gripe. If the supervisor is satisfied that evidence of slipping has occurred a retest should be carried out.

If the fabric has a tendency to slip the grips may be lined with another piece of the fabric to help cushion the strip while applying greater pressure to the grip.

If the behaviour of the fabric is unknown it is advisable to prepare an additional strip as a trial to check that the testing machine to adjusted for the correct range. For example a fabric which has a low breaking strength may require to be broken on the Goodbrand vertical machine rather than the horizontal one as the latter has a single scale of 600 kg. while the former has two scales which are smaller in capacity.

JOB BREAKDOWN

Preparation of Stripe

Steps	Key Points
1. Lay fabric flat on bench.	Smooth out creases.
2. Draft the shape of the stripe on the fabric.	Use coloured pencil Chisel point Run lines along threads. Use specification lay out.
3. Mark stripe.	
4. Cut out stripe.	Cut along threads of warp or weft.
5. Prepare fringe.	Fringed width-never under that specified.

Breaking of strips (Goodbrand horizontal machine)

Check first that the machine is set at the correct speed and that the collar is in place to give the correct test length. Switch on motor.

JOB BREAKDOWN

Step	Key Point
1. Place one end of the strip in the measuring grip and clamp.	Centre it. Adjust for thickness. Fabric squeezed not crushed.
2. Pass opposite end of strip through traversing grip.	
3. Attach clip.	Right angles to warp (weft).
4. Tension by using clip.	Just sufficient to straighten.
5. Close clamp & remove clip	As in 1.
6. Set slave pointer to zero.	
7. Engage clutch and break sample.	
8. Disengage clutch.	
9. Note reading on dial.	Record on test sheet.
10. Return traversing grip to starting position.	

Breaking of strips (Goodbrand vertical machine)

Check first that the machine is set at the correct speed and that the collar is in place to give the correct test length. Switch on motor.

Job Breakdown

Step	Key Point
1. Place end of strip in upper grip and close grip.	Centre, do not crush fabric vertical position.
2. Pass end of strip through traversing grip.	
3. Attach clip and tension strip.	Sufficient to straighten fabric.
4. Close grip.	As for 3.
5. Release clamp on upper grip.	
6. Engage clutch and break strip.	
7. Disengage clutch and return grip to start position.	
8. Note reading on dial.	Record on test sheet.
9. Release pawls on quadrant and return pendulum to zero.	
10. Tighten clamp on upper grip.	
11. Remove broken strip.	Lay aside in order of breaking.

TEAR TESTING

Strength of cloth is not always measured by tensile testing of flat strips but may be tested for resistance to tearing. The force required to tear a woven cloth is usually less than that required to break it. This is borne out by taking a fine cloth inserting a small cut at the selvedge and then tearing across to the other selvedge. Notice that such a tear proceeds along the line of a thread of weft and across the warp threads and this would be describe as testing the tear strength of the warp.

The tear strength depends first upon the type of fibre used and fibres with a high work of rupture (toughness factor) perform better than fabrics made from high strength fibres with a poor toughness rating. The yarn also plays a part as hard twisted yarns tend to break more easily than normal twisted yarns. This is particularly true where the weft tear strength is being measured and the warp has a high twist.

The cloth structure probably influences the tear strength to the greatest degree and if we consider comparisons between cloths with identical construction of ends and shots, counts and quality of yarn a plain weave will have a lower tear strength than a twill which in turn is lower than a hopsack. In other words the lower the interlacement the greater the tear resistance. The principle is that where threads have freedom of movement in the structure tear resistance is greater and this also applies to open sett cloths where the ratio of tear to tensile is better than in closely sett cloths.

The nature of the tear is revealing as it is a shear force which is applied with one set of threads shearing the other set. In open or loosely interlaced cloths the shearing force is met by a thread which moves away from it and comes up against the next thread and the force required to shear two threads is greater. In closely set cloths the yarns cannot move and the threads are ruptured one by one. The double thread used as a tear stop is based on this hypothesis.

Finishes which secure the threads in a fixed position such as coating or starching will reduce the tear strength hence the use of nylon as a backing fabric because of its toughness.

Tongue Tear Test (BS Handbook p.4/118).
Wing Rip Test (BS Handbook p.4/110).

The former is a double tear test made by cutting a tongue of cloth 50mm wide from a piece 150mm wide and tearing the tongue from the main piece of fabric for a distance of 50mm. The machine used requires an autographic recorder and the peak loads recorded for each thread are listed in value and the median point taken. Some testers will argue that the peak is the tear resistance strength and the highest recorded strength should be used. The LINRA double rip test is based on this latter premise.

The wing rip is a single rip with a sample which has been cut to provide two ends with a 55° angle on each. One end is put in each grip and the fabric torn for 50mm.

Ballistic Tear Test (BS Handbook p.4/114).

It is argued that tears occur rapidly and this test is a better simulation of the actual wear and tear than the slow tests. A strip of cloth is cut lengthwise within 25 or 100 mm from the end. One side of the cut is attached to the pendulum and one to the fixed grip. When the pendulum is released the retardation applied in tearing the sample is recorded as work of rupture. The use of the two lengths eliminates the extension effect of the long strips.

MEASUREMENT OF CRIMP AND COUNT OF YARN FROM WOVEN FABRIC

If the count of yarn from cloth samples is to be found the length used in the calculation is the length of the uncrimped yarn. With an inextensible yarn like jute a reasonably accurate measure can be obtained by pulling the yarn straight but to avoid variation the Shirley Crimp Tester is used.

The method described in the BS Handbook No.11 describes the cutting of flaps in the fabric in warp way and weft way direction to obtain the count of warp or weft respectively. It describes the use of a template and carbon paper to mark the threads but a ruler and sharp wax pencil will suffice. An alternative to marking and cutting is to cut at each end of the template with a sharp blade.

A convenient length of flap is 50cm although crimp tester will deal with greater lengths. Having cut the flap accurately 10 threads are selected and subjected to straightening to these 10 are added 40 more to give 50 threads. The uncrimped length is obtained from the 10 by selecting them one at a time in a manner which does not allow any twist to escape and the ends are placed into crimp tester. The cursor with the clamp is moved slowly along the scale until the balance is in the mid position and the length read from the scale. The average of the ten is obtained and the total length involved is obtained by :

$$\frac{50 \times \text{average length (cm)}}{100} \text{ m}$$

The 50 threads are weighed and the tex count obtained by :

$$\frac{\text{Mass in grams} \times 1000}{\text{Total length of 50 threads(m)}} = \text{Tex}$$

The tension which may be applied has two scales. 0-30g and 0-175g. The latter scale is obtained by using the red weights and it is this scale which is recommended for hessian warp and weft. A setting of about 50g is sufficient to straighten the yarn and with tension greater than this the yarn slips out of the small clamps.

If the crimp is required it can can be obtained by :

$$\frac{\text{Uncrimped length - crimped length} \times 100}{\text{crimped length}} = C\ \%$$

C % is expressed in terms of the length in the cloth hence to obtain a laid length or reed width to produce a given length or width of cloth the C % is added to the given dimensions.

E.G. Cloth width 200cm weft crimp 3%

$\therefore$ Reed width = 200 x 1.03 = 206 cm

Cloth length 500m warp crimp 2½ %

$\therefore$ laid length = 500 x 1.025 = 512.5m

The crimp ratio used in this calculation is obtained from the crimp per cent (C) as follows :

$$\frac{100 + C}{100} = C \text{ ratio}$$

E.G. C = 3% $\quad \frac{100 + 3}{100} = 1.03$

FABRIC STRENGTH - GRAB TEST

As an alternative to the testing of fringed strips the ASTM grab test may be used and this test appears in a number of jute fabric specifications. It has the advantage of being easier to prepare but more care is required in putting the specimen in the grips. The grips have at least one in each pair which measures 25.4mm (1 inch) in width and the other of a size equal to or greater than 25.4mm. The depth, measured in the same direction as the application of the load should be not less than 25.4mm not more than 50mm. The sample size is that specified but should be not less than 100mm (4 inches) wide and 145mm (6 inches) long. A line is drawn parallel to the threads under test and this line should extend from the edge of the upper grip to the edge of the lower grip to ensure that the same threads pass through both grips. It is in this marking that care is required. The relationship between the grab test and strip test on the same fabric is quoted in some of the specification for example in BDS 813 specification it quotes :

$$\text{grab test result} = \frac{\text{Strip test result}}{3.1}$$

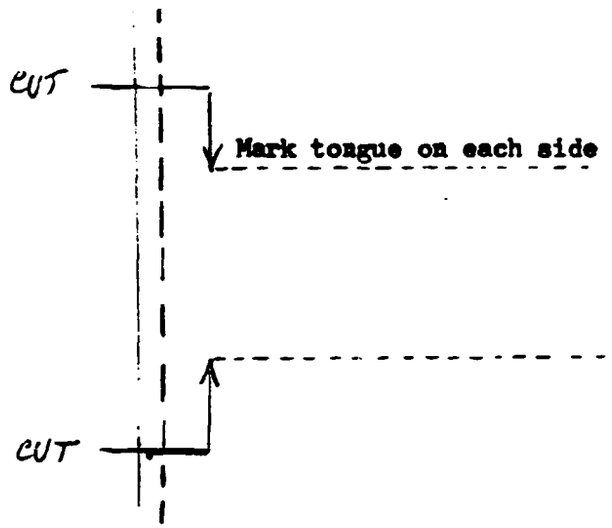
and this refers to a 4 inch strip. The B.J.T.R.A. quotes the ratio of grab test to strip test of 1.3:1 per thread which is similar to the BDS specification.

The number of tests may be given in the specification but should not be less than 5 in warp and 5 in weft direction.

The specimen should be prepared with the same precautions as for the strip test by drawing a pencil along the warp threads and along the weft threads to indicate the the edges of the cut specimen.

SEAM STRENGTH - "T" TEST

To test the strength of the seam on a bag the testspecimens are cut according to the specification. In most cases this will require about 100mm of seam with a tongue of cloth 500mm wide extending(from the centre)on each side. It is important that that these tongues are directly opposite one another on each side of the seam and that they are parallel to the cloth threads which are perpendicular to the seam. To ensure this it is preferable to cut the tongues individually. The method to adopt is to measure the 100m of seam and cut across the seam at two places as shown. Then cut towards the tongue. From the base of the tongue it should then be possible to draw lines parallel to the threads on both sides of the bag and cut the two tongues separately.



Normally five tests from each bag is sufficient and when sewn side and bottom it is preferable to cut 3 and 2 respectively.

In recording the results it is essential to note whether the seam has ruptured or the fabric. If the seams rupture in all tests it may be that the seam is too weak if none rupture it may be too strong. A mixture of seam and fabric breaks should indicate a satisfactory situation.

An alternative to the "T" test is described in the ASTM manual whereby specimens are cut 4 inches by 6 inches with the seam in the middle of the 6 inches length. The fabric specimens are then tested using the 1 inch grab grips and mounting them in the same way as for a breaking load test. This test is similar to the BS test for seam slippage.

The colour of pile carpets and particularly dense cut pile carpets appears to be lower in value and higher in chroma than the colour originally imparted to the pile yarn during dyeing. The effect of the cut pile which has small particles of shadow between each fibre tends to lower the value as the shadow is nearer to black and looking on the ends of the fibres tends to give a greater saturation hence an increase in chroma. During wear the carpet pile tends to lie flat or in the case of wool becomes felted, the pile is no longer reflecting light in the same way and there is an apparent raising in value and lowering of the chroma which is similar to light fading. The lowering of the chroma is further aggravated by uniform soiling of the carpet pile by airborne particles of dirt. Some colour changes therefore are not the result of the fading of the dyestuff used to colour the pile yarn but to these changes in the pile structure and soiling.

To test the light fastness of pile yarn therefore it is best to remove the effect of the cut pile by testing the pile yarn which may be wound flat on a card for inserting into the light fading tester. If yarn is not available from the manufacturer it can be removed from Wilton carpets by dissecting the carpet and removing the long pieces of yarn from the base of the carpet at those places where it does not figure on the surface. This is not possible with self coloured carpets as only one frame is used. It is also not possible to do this with Wilton which has been woven on the face-to-face loom as all the pile yarn is used on the surface with none carried in the base.

COLOUR FASTNESS OF DYED MATERIAL - LIGHT FASTNESS

This test is based on the rapid fading of dyed samples by exposure under controlled conditions of the material under test and comparing the results with those obtained with standard samples of known fastness. The standard samples are numbered 1 to 8 and are blue in colour. Normal colour fastness rately exceeds 6 hence the samples 7 and 8 may not be required.

The test is subjective in nature and relies on the visual appraisal of the samples to estimate the colour change which has occurred and to assist in the grading of the changes a grey scale showing five grades of contrast is available. The grey scales comprise pairs of tiles set side by side in a slide number 1 showing the greatest contrast of shade and 5 the least contrast.

The test then consists of exposing samples, in the tester comparing them with the original colour and assessing the grade on the grey scale to which the contrast most nearly approximates.

The instrument has a rapid fading light bulb mounted centrally and arranged round it are cells with glass fronts into which the fabric samples are put. The control panel has a timer which can be preset to give a number of hours exposure before switching off. A lamp life counter is also provided which is put to zero with a new lamp and is left to record the time of each test to give a total time of use of that lamp bulb. The life of a bulb is 2000 hours and thereafter the intensity falls. The fall off in intensity does not invalidate a test as the control samples experience the same exposure as the test piece but it lengthens the test and some fading characteristics are time dependant.

As some dyestuffs are heat sensitive the rectangular cells are kept cool by circulating water through the backs of the cells. There is no need therefore to cool the samples before making the assessment.

The testing required to be done is likely to be a pass/fail test to a given standard and the second method of test described in the manual is adequate. The sample under test may be placed in one cell and pieces of the standard blue fabric placed in another The numbers of the standards need only exceed by one the specification standard. e.g. for a specification of light fastness of not less than 5 the standard numbers 1 to 6 would be used. The specification may state the grade of contrast on the grey scale but if not 3 should be adopted.

Method - 2

Mounting

1. Cut pieces of card 115 x 48 mm (4½ x 1 7/8 inches)
2. Cut pieces of standard blue fabric 19 x 48 mm (¾ x 1 7/8 inches)
3. Attach the standard fabrics to the card (staple or 2 sided adhesive tape) in numerical order one above the other
4. Cut the sample(s) under test to a suitable size and attach to card(s).

Inserting in the instrument

1. Press down on a cell and tilt forward to expose top.
2. Left top and withdraw the metal sample holder.
3. Remove cover and place card with mounted standards or sample against the back of the plate.
4. Replace spring cover.
   (Note - The cover is designed to expose two strips of the sample to the light and cover the rest).
5. Replace sample holder.
6. Replace cell lid and relocate in body of instrument.
7. Set the timer for the desired hours of exposure.
8. Switch on the instrument.
9. Turn on the cooling water.

The manual gives some approximate times for a given level of fading and as each standard is twice as fast as the one below it numerically the hours have a similar relationship.

10. When the time of exposure has elapsed remove the standard samples and compare with the grey scale 3.

11. Continue exposing and comparing until standard 1 has faded to grade 3 and record the hours.

12. Repeat steps 10 and 11 for standard 2, 3 and so on until the specification standard has faded to graded 3.

13. Remove the test sample and compare with grade 3. If it has a greater contrast ie 1 or 2 it has failed but a contrast of 3, 4 or 5 would be a pass.

If the actual fastness rating is required steps 10 and 11 may be repeated until the sample fades to a contrast of grade 3. The fastness rating will then be the number of the standard sample which coincides with the test sample. The number of hours required for grades 7 and 8 are very high hence many tests would just record "better than 6" as a fastness rating. If the contrast is better than 5 but poorer than 6 then the colour fastness may be quoted 5/6.

COLOUR FASTNESS OF DYED MATERIALS - RUBBING FASTNESS

Crocking is the removal of dye stuff by rubbing and the instrument used to assess this is the crockmeter. Fastness to rubbing is important in those cloths which are used for upholstery and to a certain extent carpets come into this category as clothing comes in contact with the floor covering although to a lesser extent than chair coverings.

The rubbing fastness may be tested by dry rubbing where the crocking cloth and the material under test are conditioned and wet rubbing where the crocking cloth contains 100% moisture.

The crocking cloth is mounted on the rubbing finger of the instrument and the material under test is mounted under the clamps on the base of the instrument. The finger is lowered on to the specimen and the handle is turned to give 10 cycles. The crocking cloth is then removed and compared with the grey scales for staining. The latter comprises pairs of tiles showing degrees of contrast of white with grey. Rating 5 is unstained or two white tiles and lower ratings have a white tile paired with a grey one with increasing contrast to 1. The rating is the number of contrast which coincide with that of the sample. Where the sample is better than one contrast but not as good as the next both numbers may be used. E.G. Better than 4 but not so good as 5 would be 4/5.

CARPET TESTING

The performance of a carpet during wear depends upon the construction used, the pile yarn properties and the efficiency of the backing material.

Carpets are constructed either by weaving by the traditional Wilton or Axminster methods or by tufting.

Most of the jute carpets are made with the Wilton weave which employs a warp chain to bind the structure, a stuffer yarn which is there to add bulk, a weft yarn which in conjunction with the chain forms the basic weave and a pile yarn which makes the face of the fabric. The last named usually makes up the greatest part of the carpet and it is the performance and appearance of the pile yarn which is important. Wilton carpets have few colours in the pattern as the method of weaving limits the number to a maximum of six in normal cases although with planting the number of colours may be increased. The greater the number of colours the more expensive the carpet will be as the colours not employed in the pile at any one point are buried in the base of the carpet along with the stuffer.

Testing of carpets is aimed at the performance of the pile yarn mainly and the following tests are available :

Thickness measurement
Recovery from static loading (compression and recovery)
Abrasion resistance
Resistance to dynamic loading
Tuft withdrawal tension

As the pile yarn makes up the largest part of the carpet the cost is usually related to the number of pile tufts per square area and the length of tufts. The wear is also related in this way and the greater the length and density of the pile the longer will be the wearing life of the carpet. In addition to the tests listed therefore it might be necessary to count the tufts per unit length in warpway and weftway, measure the pile height and calculate the mass per square area. A full analysis of the carpet is unlikely to be required but if the results of the listed tests are to be related to the carpet construction it might be necessary to do so.

Thickness measurement

The WIRA model combines the measurement of thickness with the ability to measure recovery of the pile from static loading. The handbook describes the method used and emphasises that the presser foot should be lowered gently on to the specimen to prevent excessive crushing. The BS handbook No.11 states that 10 readings are required for pile carpets and the mean thickness is quoted in the test report. The pressure is given as 1.96×10^{-3} N/mm^2 which is equal to 2×10^{-3} Pascals as quoted in the handbook.

Static loading

The WIRA Handbook describes a test whereby the carpet specimen may be loaded progressively and the thickness measured at each stage in the loading. Similarly the load can be removed progressively and the thickness recorded at each stage. If the values are plotted on a graph of thickness against pressure a compression and recovery curve can be prepared.

Alternatively the load can be applied progressively until the thickness reaches its minimum or maximum load has been applied. The load may be left for 1 hour or longer up to 24 hours and then removed. The recovery of the pile which is left flat in the conditioned atmosphere can be measured at intervals until the thickness reaches a point where no further recovery occurs. The difference between the original thickness and the recovered thickness can be calculated as shown in the handbook but in this case the recovery is after removal of load and the period of time should be noted. The recovery curve can be plotted on a base of time against thickness.

Dynamic loading

The static loading test might indicate the behaviour of the carpet pile as a result of crushing by pieces of furniture resting on it but to estimate its wearing property the dynamic test is used. It is intended to simulate traffic over a carpet and is designed to accelerate the wear. BS 4052 describes the test and suggests that 2 specimens be used to give a mean loss of thickness as a result of a given number of impacts. In comparing carpets of different construction it is easier to use a fixed number of impacts and express the comparison as difference in thickness loss. Alternatively the specimens may be compared by impacting to a given thickness loss and the number of impacts required will give a comparison. In both of these cases the thickness is measured immediately but a real comparison involves recovery in addition to crushing and the recovery curves for the two carpets may be obtained by measuring the thickness at intervals over a given period of time.

Abrasion testing

Crushing by static or dynamic loads may alter the appearance of the carpet but abrasion will remove the pile surface by reducing its height without any recovery. The WIRA carpet abrasion machine employs a rotary disc with a standard abrasion fabric which is running in contact with a small rotating disc of the carpet under test and at a standard pressure. Comparison of abrasion resistance of carpets can be carried out to assess the suitability of pile height, density and material.

The end point of an abrasion is difficult to obtain and the B.S. uses a number of illustrations to show the amount of backing which shows at the end point. It is described as the point where the pile has worn to show the backing yarns. The backing may show if the tufts part at one point and it is the identification of this type of exposure of the backing which is difficult to achieve. If a number of specimens are tested the mean number of cycles can be obtained and any one which is very far below the mean can be examined carefully to check if the correct end point has been reached.

The alternative test is to check the loss of mass at intervals of 100, 200, and so on until the end point. This is done by weighing the specimen before the start and after each group of cycles. As the detritus from the abrading may remain on the specimen it should be lightly dusted before each weighing. The weight loss can be plotted against the number of rubs to compare the performance of two or more carpets, and the mean loss in mg/1000 rubs calculated.

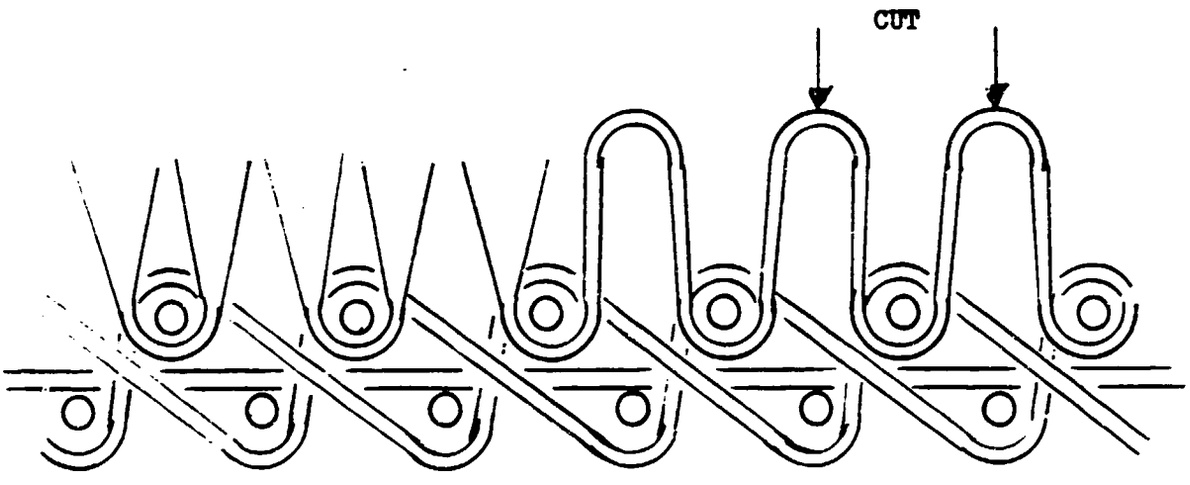
Tuft withdrawal tensometer

If the pile tufts are inadequately anchored into the base structure they will be removed easily by wear and the carpet will become inserviceable. Poor tuft anchorage is results from faulty structure or an inadequate application of back filler such as latex. In Axminster carpets where the pile is laid into the structure on the surface only it is a more likely fault than in Wilton carpets. The firmness of the binding of the tufts into the base structure can by measuring the force required to withdraw it. The WIRA machine has a pair of scissors which can grip a single tuft. The scissors are attached to a spring balance which is slowly raised by the motor driven pully. The tension is indicated on the spring balance. As there is no slave pointer on the balance the operator must watch the pointer and note the reading at its highest point to obtain the withdrawal tension.

Alternatively if a tuft withdrawal tension is specified then out of a number of tests those which fail to reach the tension can be counted.

The tufts selected for testing should be distributed as widely as possible and adjacent tufts should not be used. Check also that only one tuft is withdrawn and where ply yarns are used ensure that all the plies have been withdrawn. The tufts may be picked out by folding the carpet along a weft shot to make the row of tufts stand out.

When testing looped pile the loops may be cut on either side as shown :



PILE HEIGHT IN CARPETS

When analysing a carpet sample it is easy to separate a number of tufts and measure these using tweezers and a rule marked in 0.5mm. An average length may be taken for a number of readings and a sample of 25 would be sufficient to obtain reasonable accuracy. As part of the pile is within the backing fabric the tuft length does not give the pile height. This can be obtained by taking five readings of the carpet thickness at different places and then removing the surface pile by clipping it away at the same places. If sharp scissors are used it should be possible to remove all the pile down to the backing at five places and measure the reduced thickness. The difference should be the pile height.

CARPET ANALYSIS

If a carpet analysis is required it can be done by weighing as large a sample as possible to obtain the overall mass per square metre. From the large sample a small rectangle of about 10 cm square can be cut and dissected carefully placing all the various constituent yarns into separate bundles. As the method of interlacement is not usually in any doubt it is the proportion of each yarn used which is required. When the yarns are all separated weigh each bundle and express the result as a percentage of the whole.

E.G.

Weft single jute yarn	..	0.9255	6.5%
Stuffer warp 2 ply jute woven double	..	1.9262	14.0%
Cotton chain warp 3 x 3 cabled	..	1.4919	10.5%
Pile yarn 2 ply jute dyed	..	9.8937	69.0%
		14.2373	100 %

FRICTION IN TEXTILES

During the processing of textile fibres to convert them into finished products the materials are subjected to frictional effects with those parts of the machines with which they come in effects. In some cases it is essential that this contact is frictional while in others it is undesirable. Where it is essential to introduce tension into yarns and fabrics there are two principle methods of doing this.

Additional tension devices: Where the material subject to pressure between two surfaces the frictional effect represented by the formula :

$$T_2 = T_1 + 2P\mu$$

Where T_2 is the final tension

T_1 is the initial tension

P is the pressure asserted by the two surfaces

μ is the coefficient of friction between the surface and the textile material

Multiplier tension devices: Where the material passes round a surface making an angle of lap and is represented by the formula :

$$\frac{T_2}{T_1} = E^{\mu\theta}$$

where E is the basis of the naperian logs (epsilon)

μ is the coefficient of friction

θ is the angle of lap in radians

This is the well known coil friction formula and as the value of μ and e are exponential a small change in either will make a big change in the multiplying ratio.

Many tension devices make use of both principles and the calculation then becomes more complicated. E.G. In a disc and post type where the yarn passes between two discs to which a pressure is applied and passes round the post in the centre, half the additional part is added, it is then multiplied and the other half added to that. There are really 4 tensions, the initial entry tension (T_1) the tension before the post (T_2) the tension after the post (T_3) and the final tension (T_4). The result is :

$$T_1 + P\mu = T_2 \qquad \text{(note 0.5 of 2 } P\mu\text{)}$$

$$T_2 \times E^{\mu\theta} = T_3$$

$$T_3 + P\mu = T_4$$

or $$E^{\mu\theta}(T_1 + P\mu) + P\mu = T_4$$

Measurement of the coefficient of friction is the most difficult part as the pressure is easily obtained and the angle of lap can be measured. The Shirley Yarn Friction recordor measures the coefficient of friction of yarn to polished steel and while all surfaces are not made of this substance the performance of different yarns can be compared. If a yarn is treated to increase its coefficient of friction the change measured against the polished steel will indicate the magnitude giving some measure of the likely change against other smooth surfaces. It is worth noting that generally rough surfaced yarns against a smooth surface and smooth surfaced yarns against a rough surface produce low coefficients of friction.

Hence rough jute has a low coefficient with glass, glazed ceramics and polished steel while continuous filament nylon will have a low coefficient of friction with satin finished steel and unglazed ceramics or ground glass. In the case of jute yarns changes in the batching oil may alter the value of μ and its measurement would give an indication of the fibre andyarn behaviour during processing. The magnitude of the values likely to be recorded for most yarns is between 0.2 and 0.4 and the lower range (0.0 - 0.6) is suitable. Values higher than 0.6 are rare and if experienced might cause serious problems during processing.

Air Permeability Testing

Cloth cover is a measure of the area covered by threads in the fabric to that which is uncovered and may be expressed as a fraction i.e. 1.0 is total cover and values lie between that and 0.0. As the cover indicates the closeness of the setting of threads and the size of the threads it can be calculated from the formula.

$$K = \frac{\text{Tex x threads/dm}}{2680}$$

for warp and for weft. (K_p and K_t)

A unique value for the cloth may be obtained by the formula.

$$K_{cloth} = K_p + K_t - (K_p \times K_t)$$

This value of cover is related to a number of cloth properties among which is the passage of fluid through the fabric. A measure of the latter can be obtained by using the air flow meter to measure the pressure drop when air is passed through the fabric and this drop is a measure of the resistance to air flow presented by the fabric.

The air flow meter has four scales or Rotometers and for most jute fabrics the largest or number one will be sufficient. Indeed many hessian fabrics will have an air flow which is outside the scope of the instrument. Tarpaulin fabrics which have high cover values probably as high as 0.84 should give low readings of air permeability and might require the use of Rotometer No.2.

MEASUREMENT OF MASS PER SQUARE AREA OF FABRIC

This is most likely to be done by the inspector at the mill where the bulk is available and a more realistic result can be obtained. If it is required to be done in the laboratory it is best done on the largest sample available i.e before cutting off parts for other tests. If the sample piece is rectangular and this applies in most cases, measure the length and width carefully. The BS No.11 handbook states that the sample should be cut at right angles to the selvedge and that the measurement should be done to an accuracy of 0.5%. If the sample is then weigh correct to 1 part in 500 the mass per m^2 or per yd^2 can be computed.

If the count and crimp of the warp and weft and the ends and shots have also been obtained during the test a cross check can be made by calculating the mass per square area using the information obtained.

$$\text{Mass of warp or weft} = \frac{\text{Th/dm} \times 10 \times \text{crimp ratio} \times \text{tex}}{1000} = \quad \text{g}$$

The mass of warp and weft are calculated and the sum of the two gives the mass per m^2 of the fabric.

Similarly if the ends and shots per inch are used with the yarn number in lb/sp the calculation is made using the following formula.

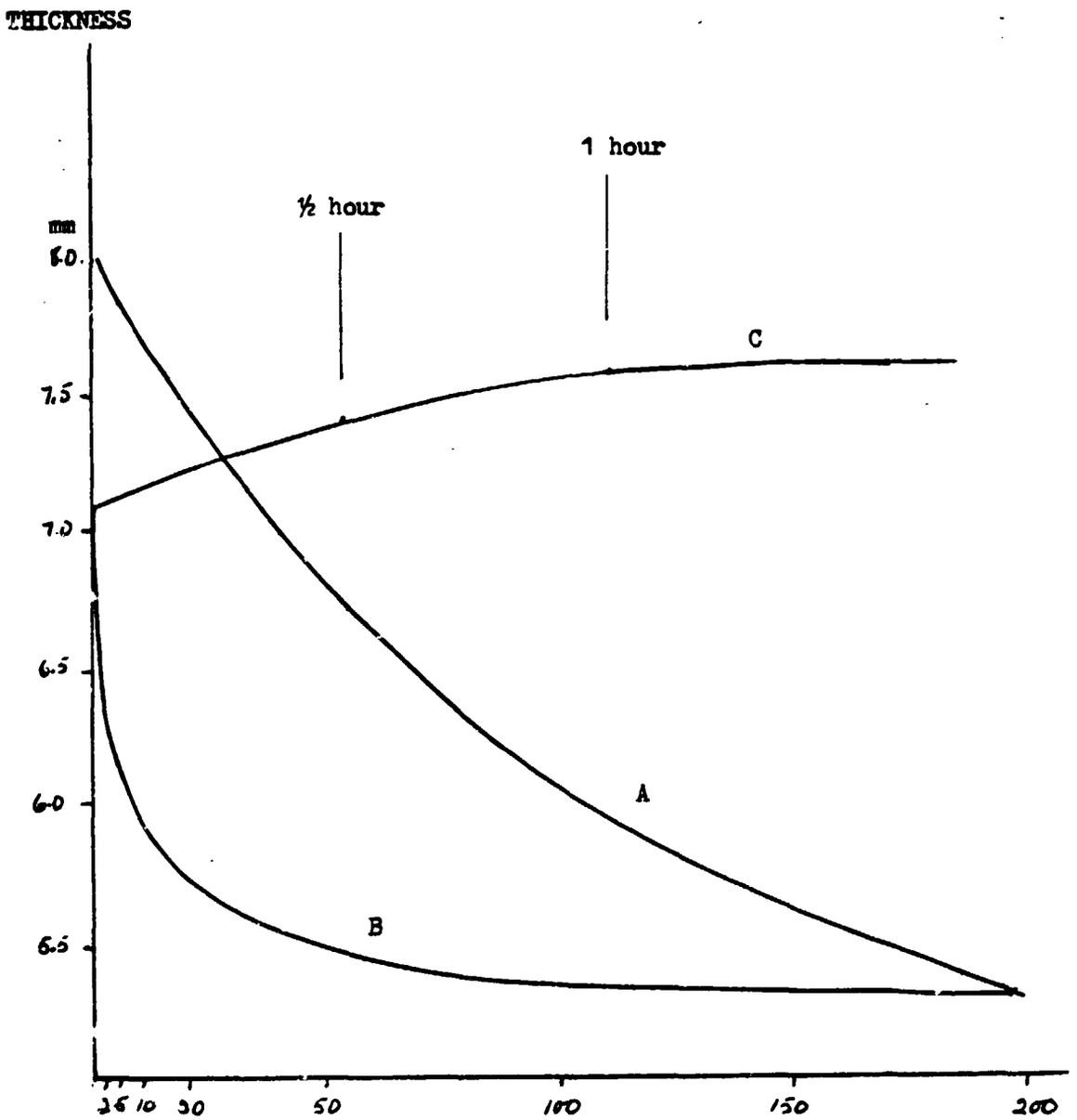
$$\text{Mass of warp or weft} = \frac{\text{Th/inch} \times 36 \times \text{crimp ratio} \times \text{lb/sp} \times 16}{14400} = \quad \text{oz.}$$

These formulae are set out in full but may be simplified by combining the constant values into one.

Compression and Recovery of Carpets

Typical graph showing the changes in thickness under progressive loading (A) and unloading (B) and unrestricted recovery (C). This shows a total recovery of 95% i.e. final thickness is 95% of the original thickness.

Wilton Jute Pile Carpet



ANNEX - 3

Personnel engaged on project BGD/79/030 :

International Staff

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National Counterparts

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