

**Textile testing &** **Quality Control – I Lab
(TE-231) - LAB MANUAL**

**List of Experiments**

1. Layout of Textile Testing and Quality control I Lab.
2. Determination of Relative Humidity (RH%) by wet and dry bulb hydrometer.
3. Determination of sliver count by wrap block and digital balance.
4. Determination of roving count by wrap block and digital balance.
5. Determination of yarn count by wrap reel and digital balance.
6. Determination of yarn count from plain fabric by Beesley’s Balance.
7. Determination of yarn count from denim fabric by Beesley’s Balance.
8. Determination of trash% from cotton fiber by trash analyser.
9. Determination of moisture regain of cotton and polyester yarn by Moisture Regain Tester (MR%).
10. Determination of amount of twist (TPM) by twist tester



**Daffodil International University
Department of Textile Engineering**

**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 01

**Experiment name:** Layout of Textile Testing and Quality control I Lab.

**Objectives:**

* To know about the names of the machines and equipment present in Lab
* To know about the origin of the machines and equipment present in Lab
* To know about the functions of machines
* To write a note according to the experiment.

**Lay-out and Description:**

Machine: 1

Name: Wet and dry bulb hygrometer.

Origin:

Brand:

Model no.:

Function: Determines relative humidity and temperature.

Machine: 2

Name: Digital twist tester.

Origin:

Brand:

Model no:

Function: Measures twist of yarn.

Machine: 3

Name: Wrap block.

Origin:

Brand:

Model no:

Function: Determines length of sliver and roving.

Machine: 4

Name: Wrap reel.

Origin:

Brand:

Model no:

Function: Determines length of yarn.

Machine: 5

Name: Yarn strength tester.

Origin:

Brand:

Model no:

Function: Determines yarn strength.

Machine: 6

Name: Trash analyzer

Origin:

Brand:

Model no:

Function: Measure trash% from fibers.

Machine: 7

Name: Beesley’s balance

Origin:

Brand:

Model no:

Function: Measures yarn count of short length.

Machine: 8

Name: Moisture regain tester

Origin:

Brand:

Model no:

Function: Determines moisture regain of fiber.

Machine: 9

Name: Digital balance

Origin:

Brand:

Model no:

Function: Measures weight of silver/yarn.

**Conclusion/Remarks:**

In order to perform all the experiments properly we need to know all the machines in our lab and we need to identify each of them individually. So, the experiment is very important.



**Daffodil International University
Department of Textile Engineering**

**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 02

**Experiment name:** Determination of Relative Humidity % (RH%) by wet and dry bulb hygrometer.

**Objective:**

* To maintain atmospheric condition of testing laboratory
* To obtain good efficiency in work place
* To know wet and dry bulb hygrometer
* To relative humidity is used to maintain physical properties of the fiber.

**Theory:**

We know that,

Relative humidity = (Actual vapor pressure/ Saturated vapor pressure) ×100%

The Actual vapor pressure ratio to standard vapor ratio pressure ratio at the same temperature defines as the percentage is called relative humidity percentage.

The Wet and Dry Bulb Hygrometer / Thermometer is used to measure the amount of moisture in the environment. The hygrometer measures the wet and dry temperature over the range of -10 to +50°C enabling the relative humidity to be calculated (1 to 97% RH). The unit incorporates a small water reservoir

**Atmospheric condition:**

RH(%) =

Temperature =

**Apparatus:**

 Wet and dry bulb hygrometer, water, muslin fabric.

**Machine diagram:**



Wet & Dry Bulb Hygrometer

**Working Procedure:**

* At first, we took wet bulb reading.
* Then we took dry bulb reading.
* Then we have to calculate the difference.
* Then we took the reading by changing the dial to the point of difference we got earlier and noted it down.
* It is the relative humidity percentage.

**Calculation:**

Dry bulb temperature = \_\_°C

Wet bulb temperature = \_\_°C

Difference = (Dry-Wet) °C

 = \_\_°C

Relative Humidity reading = \_\_%

**Result:**

Relative humidity in room temperature = \_\_%

**Comment/conclusion:**

By doing this experiment we learned to use wet and dry bulb hygrometer to determine relative humidity percentage. We can use this to understand the testing environment.



**Daffodil International University
Department of Textile Engineering**

**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 03

**Experiment name:** Determination of sliver count by wrap block and digital balance.

**Objective:**

1. To know about yarn count system.
2. To know about wrap block & digital balance.
3. To know how to determine the sliver count by wrap block & digital balance.

**Theory:**

Count is a numerical value, which express the coarseness or fineness (diameter) of the yarn and also indicate the relationship between length and weight (the mass per unit length or the length per unit mass) of that yarn.

The fineness of the yarn is usually expressed in terms of its linear density or count. There are a number of systems and units for expressing yarn fineness. But they are classified as follows

Types of Yarn Count:

1. Direct Count System
2. Indirect Count System

Direct Count System:
The weight of a fixed length of yarn is determined. The weight per unit length is the [yarn count](http://textilelearner.blogspot.com/2013/07/yarn-count-system-and-conversions.html)! The common features of aII direct count systems are the length of yarn is fixed and the weight of yarn varies according to its fineness.

Tex: In the direct universal Tex system, the yarn count number indicates “the weight in grams of 1000 meters of yarn”.

e.g. 30 Tex indicates that 1000 meters of yarn weight 30 grams.



Indirect Count System:
The length of a fixed weight of yarn is measured. The length per unit weight is the yarn count. The common features of all indirect count systems are the weight of yarn is fixed and the Length of yarn varies according to its fineness.

English Cotton Count (Ne): In the indirect English cotton count system, the yarn count number indicates “number of 840 yard hanks of yarn per 1 pound weight”.

e.g. 40/2’s (2 means ply yarn) indicates that 20(Resultant count)x 840 yards of yarn weight 1 pound.



**Atmospheric condition:**

RH(%) =

Temperature =

**Apparatus:**

Wrap block, sliver, digital balance.

**Machine diagram:**



Wrap block machine



Digital Balance

**Working procedure:**

1. At first, we have taken the stock sliver.
2. Then we have taken one end of sliver.
3. Then we set the end of sliver drum of wrap block.
4. As the circumference of wrap block is 1 yd then rotate three times for taking 3 yds sliver.
5. Then weight is taken for 3 yds sliver by balance.
6. Then we calculated the count by the equation.
7. Now average count is calculated.

**Data Table:**

Direct Count

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. of observations | Sample Weight(gm) | Sample Length(yds) | Unit Weight(gm) | Unit Length(m) | Count(Tex) | Average count |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Indirect Count

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. of observations | Sample Weight(gm) | Sample Length(yds) | Unit Weight(lb) | Unit Length(yd) | Count(Ne) | Average count |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**Calculation:**

 Sample yarn weight (gm) X 1000 m

Tex count = ……………………………………………………

 Sample yarn length (m) X 1 gm

 Sample yarn length (yds) X 1 lb

English cotton count (Ne) = ………………………………………………

 Sample yarn weight (lb) X 840 yds

**Result:**

The count of sliver in Tex is ……………….

The count of sliver in Ne is ……………….

**Comment/conclusion:**

Sliver is very important for producing Quality yarn. This is very important experiment for all textile students. Quality control is a ma6or side for textile sector because there no sector in textile engineering where need not Quality control. Therefore, from the above we can easily understand the importance of the experiments in the field of textile quality control. We want to establish us as a qualified professional skilled manpower of this sector for that we practice this experiment in textile testing & quality control lab.



**Daffodil International University
Department of Textile Engineering**

**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 04

**Experiment name:** Determination of roving count by wrap block and digital balance.

**Objective:**

1. To know about yarn count system.
2. To know about wrap block & digital balance.
3. To know how to determine the roving count by wrap block & digital balance.

**Theory:**

Count is a numerical value, which express the coarseness or fineness (diameter) of the yarn and also indicate the relationship between length and weight (the mass per unit length or the length per unit mass) of that yarn.

The fineness of the yarn is usually expressed in terms of its linear density or count. There are a number of systems and units for expressing yarn fineness. But they are classified as follows

Types of Yarn Count:

1. Direct Count System
2. Indirect Count System

Direct Count System:
The weight of a fixed length of yarn is determined. The weight per unit length is the [yarn count](http://textilelearner.blogspot.com/2013/07/yarn-count-system-and-conversions.html)! The common features of aII direct count systems are the length of yarn is fixed and the weight of yarn varies according to its fineness.

Tex: In the direct universal Tex system, the yarn count number indicates “the weight in grams of 1000 meters of yarn”.

e.g. 30 Tex indicates that 1000 meters of yarn weight 30 grams.



Indirect Count System:
The length of a fixed weight of yarn is measured. The length per unit weight is the yarn count. The common features of all indirect count systems are the weight of yarn is fixed and the Length of yarn varies according to its fineness.

English Cotton Count (Ne): In the indirect English cotton count system, the yarn count number indicates “number of 840 yard hanks of yarn per 1 pound weight”.

e.g. 40/2’s (2 means ply yarn) indicates that 20(Resultant count)x 840 yards of yarn weight 1 pound.



**Atmospheric condition:**

RH(%) =

Temperature =

**Apparatus:**

Wrap block, roving, digital balance.

**Machine diagram:**



Wrap block machine



Digital Balance

**Working procedure:**

1. At first, we have taken the stock roving.
2. Then we have taken one end of roving.
3. Then we set the end of roving drum of wrap block.
4. As the circumference of wrap block is 1 yd then rotate nine times for taking 9 yds sliver.
5. Then weight is taken for 9 yds sliver by balance.
6. Then we calculated the count by the equation.
7. Now average count is calculated.

**Data Table:**

Direct Count

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. of observations | Sample Weight(gm) | Sample Length(yds) | Unit Weight(gm) | Unit Length(m) | Count(Tex) | Average count |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Indirect Count

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. of observations | Sample Weight(gm) | Sample Length(yds) | Unit Weight(lb) | Unit Length(yd) | Count(Ne) | Average count |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**Calculation:**

 Sample yarn weight (gm) X 1000 m

Tex count = ……………………………………………………

 Sample yarn length (m) X 1 gm

 Sample yarn length (yds) X 1 lb

English cotton count (Ne) = ………………………………………………

 Sample yarn weight (lb) X 840 yds

**Result:**

The count of roving in Tex is ……………….

The count of roving in Ne is ……………….

**Comment/conclusion:**

Roving is very important for producing Quality yarn. This is very important experiment for all textile students. Quality control is a ma6or side for textile sector because there no sector in textile engineering where need not Quality control. Therefore, from the above we can easily understand the importance of the experiments in the field of textile quality control. We want to establish us as a qualified professional skilled manpower of this sector for that we practice this experiment in textile testing & quality control lab.



**Daffodil International University
Department of Textile Engineering**

**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 05

**Experiment name:** Determination of yarn count by wrap reel and digital balance.

**Objective:**

1. To know about yarn count system.
2. To know about wrap reel & digital balance.
3. To know how to determine the yarn count by wrap reel & digital balance.

**Theory:**

Count is a numerical value, which express the coarseness or fineness (diameter) of the yarn and also indicate the relationship between length and weight (the mass per unit length or the length per unit mass) of that yarn.

The fineness of the yarn is usually expressed in terms of its linear density or count. There are a number of systems and units for expressing yarn fineness. But they are classified as follows

Types of Yarn Count:

1. Direct Count System
2. Indirect Count System

Direct Count System:
The weight of a fixed length of yarn is determined. The weight per unit length is the [yarn count](http://textilelearner.blogspot.com/2013/07/yarn-count-system-and-conversions.html)! The common features of aII direct count systems are the length of yarn is fixed and the weight of yarn varies according to its fineness.

Tex: In the direct universal Tex system, the yarn count number indicates “the weight in grams of 1000 meters of yarn”.

e.g. 30 Tex indicates that 1000 meters of yarn weight 30 grams.



Indirect Count System:
The length of a fixed weight of yarn is measured. The length per unit weight is the yarn count. The common features of all indirect count systems are the weight of yarn is fixed and the Length of yarn varies according to its fineness.

English Cotton Count (Ne): In the indirect English cotton count system, the yarn count number indicates “number of 840 yard hanks of yarn per 1 pound weight”.

e.g. 40/2’s (2 means ply yarn) indicates that 20(Resultant count)x 840 yards of yarn weight 1 pound.



**Atmospheric condition:**

RH(%) =

Temperature =

**Apparatus:**

Wrap reel, yarn, digital balance.

**Machine diagram:**



Wrap reel machine



Digital Balance

**Working procedure:**

1. At first, we have taken the stock yarn.
2. Then we have taken one end of yarn.
3. Then we set the end of yarn to the reel of wrap reel.
4. As the circumference of wrap reel is 1 yd then rotate nine times for taking 9 yds yarn.
5. Then weight is taken for 9 yds of yarn by balance.
6. Then we calculated the count by the equation.
7. Now average count is calculated.

**Data Table:**

Direct Count

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. of observations | Sample Weight(gm) | Sample Length(yds) | Unit Weight(gm) | Unit Length(m) | Count(Tex) | Average count |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

Indirect Count

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. of observations | Sample Weight(gm) | Sample Length(yds) | Unit Weight(lb) | Unit Length(yd) | Count(Ne) | Average count |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**Calculation:**

 Sample yarn weight (gm) X 1000 m

Tex count = ……………………………………………………

 Sample yarn length (m) X 1 gm

 Sample yarn length (yds) X 1 lb

English cotton count (Ne) = ………………………………………………

 Sample yarn weight (lb) X 840 yds

**Result:**

The count of yarn in Tex is ……………….

The count of yarn in Ne is ……………….

**Comment/conclusion:**

Yarn is very important for producing Quality fabric. This is very important experiment for all textile students. Quality control is a major side for textile sector because there no sector in textile engineering where need not Quality control. Therefore, from the above we can easily understand the importance of the experiments in the field of textile quality control. We want to establish us as a qualified professional skilled manpower of this sector for that we practice this experiment in textile testing & quality control lab.



**Daffodil International University
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**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 06

**Experiment name:** Determination of yarn count from plain fabric by Beesley’s Balance.

**Objective:**

* To know about yarn count.
* To know about template & beesley balance.
* To know how to determine the count by template & beesley balance.

**Theory:**

Count is a numerical value, which express the coarseness or fineness (diameter) of the yarn and also indicate the relationship between length and weight (the mass per unit length or the length per unit mass) of that yarn.

The fineness of the yarn is usually expressed in terms of its linear density or count. There are a number of systems and units for expressing yarn fineness. But they are classified as follows

Types of Yarn Count:

1. Direct Count System
2. Indirect Count System

Direct Count System:
The weight of a fixed length of yarn is determined. The weight per unit length is the yarn count! The common features of aII direct count systems are the length of yarn is fixed and the weight of yarn varies according to its fineness.

Tex: In the direct universal Tex system, the yarn count number indicates “the weight in grams of 1000 meters of yarn”.

e.g. 30 Tex indicates that 1000 meters of yarn weight 30 grams.



Indirect Count System:
The length of a fixed weight of yarn is measured. The length per unit weight is the yarn count. The common features of all indirect count systems are the weight of yarn is fixed and the Length of yarn varies according to its fineness.

English Cotton Count (Ne): In the indirect English cotton count system, the yarn count number indicates “number of 840 yard hanks of yarn per 1 pound weight”.

e.g. 40/2’s (2 means ply yarn) indicates that 20(Resultant count)x 840 yards of yarn weight 1 pound.



**Atmospheric condition:**

RH(%) =

Temperature =

**Apparatus:**

1. Template
2. Beesleys Balance
3. Knife
4. Marking pen
5. Needle

**Machine diagram:**

**Working procedure:**

1. Collect sample by appropriate sampling method.
2. This Sample conditioning at testing atmosphere.
3. Marked the fabric by using template
4. Cut that’s fabric by knife according to the marking.
5. The pointer is set directly opposite to the detum line, with no material and counter weight in their proper places, by adjusting the leveling screw. The counter weight for the particular length which is supplied with the instrument is chosen and suspended at the notch D. (For full cotton the large rider is placed in the notch and for ½ cotton small rider is placed)
6. Now yarn is withdrawn from sample and placed sample hook until the pointer comes in level with the detum line.
7. At that stage the threads are taken out and counted which givers directly the cont of yarn teken for testing.
8. There 30 threads in the sample hook at the balanced condition so the count of the yarn is 30s

**Data Table:**

Direct Count

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. of observations | Types of Sample | Warp Count | Average count | Weft Count | Average count |
|  |  |  |  |  |  |
|  |  |  |
|  |  |  |

**Result:**

Average count of Plain fabric

**Comment/conclusion:**

We should yarn withdrawn from fabric very carefully. Marked fabric very carefully. It is the very easy process but if we cannot use template properly according to yarn type and idle weight than the result will be faulty.



**Daffodil International University
Department of Textile Engineering**

**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 07

**Experiment name:** Determination of yarn count from Denim fabric by Beesley’s Balance.

**Objective:**

* To know about yarn count.
* To know about template & beesley balance.
* To know how to determine the count by template & beesley balance.

**Theory:**

Count is a numerical value, which express the coarseness or fineness (diameter) of the yarn and also indicate the relationship between length and weight (the mass per unit length or the length per unit mass) of that yarn.

The fineness of the yarn is usually expressed in terms of its linear density or count. There are a number of systems and units for expressing yarn fineness. But they are classified as follows

Types of Yarn Count:

1. Direct Count System
2. Indirect Count System

Direct Count System:
The weight of a fixed length of yarn is determined. The weight per unit length is the yarn count! The common features of aII direct count systems are the length of yarn is fixed and the weight of yarn varies according to its fineness.

Tex: In the direct universal Tex system, the yarn count number indicates “the weight in grams of 1000 meters of yarn”.

e.g. 30 Tex indicates that 1000 meters of yarn weight 30 grams.



Indirect Count System:
The length of a fixed weight of yarn is measured. The length per unit weight is the yarn count. The common features of all indirect count systems are the weight of yarn is fixed and the Length of yarn varies according to its fineness.

English Cotton Count (Ne): In the indirect English cotton count system, the yarn count number indicates “number of 840 yard hanks of yarn per 1 pound weight”.

e.g. 40/2’s (2 means ply yarn) indicates that 20(Resultant count)x 840 yards of yarn weight 1 pound.



**Atmospheric condition:**

RH(%) =

Temperature =

**Apparatus:**

1. Template
2. Beesleys Balance
3. Knife
4. Marking pen
5. Needle

**Machine diagram:**

**Working procedure:**

1. Collect sample by appropriate sampling method.
2. This Sample conditioning at testing atmosphere.
3. Marked the fabric by using template
4. Cut that’s fabric by knife according to the marking.
5. The pointer is set directly opposite to the detum line, with no material and counter weight in their proper places, by adjusting the leveling screw. The counter weight for the particular length which is supplied with the instrument is chosen and suspended at the notch D. (For full cotton the large rider is placed in the notch and for ½ cotton small rider is placed)
6. Now yarn is withdrawn from sample and placed sample hook until the pointer comes in level with the detum line.
7. At that stage the threads are taken out and counted which givers directly the cont of yarn teken for testing.
8. There 30 threads in the sample hook at the balanced condition so the count of the yarn is 30s

**Data Table:**

Direct Count

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. of observations | Types of Sample | Warp Count | Average count | Weft Count | Average count |
|  |  |  |  |  |  |
|  |  |  |
|  |  |  |

**Result:**

Average count of Denim fabric

**Comment/conclusion:**

We should yarn withdrawn from fabric very carefully. Marked fabric very carefully. It is the very easy process but if we cannot use template properly according to yarn type and idle weight than the result will be faulty.



**Daffodil International University
Department of Textile Engineering**

**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 08

**Experiment name:** Determination of trash% from cotton fiber by Trash Analyzer.

**Experiment no:** 09

**Experiment name:** Determination of moisture regain of cotton by Moisture Regain Tester (MR%).

**Objective:**

1. To determine the moisture regain of cotton.

2. To know about working principles of moisture regain tester.

3. To know standard moisture regain of cotton.

4. To write a short report basis on this experiment.

**Theory:**

Moisture regain is defined as the percentage of water present in a material of woven dry weight.

the percentage of moisture in a textile material brought into equilibrium with a standard atmosphere after partial drying   as a percentage of a moisture a free- weight.

Let,

Oven dry weight = D

Weight of water = W

Moisture regain = MR

MR = 100W / D %

Standard Moisture regain: Standard moisture regain for cotton fibre is about 8.5%.

Testing condition of lab : Temperature maintain in laboratory is about 25 deg C and RH is about 74%

**Atmospheric condition:**

RH(%) =

Temperature =

**Apparatus:**

Moisture Regain Tester, Cotton Fabric

**Machine diagram:**

**Working procedure:**

1. At first we collect a tester fiber as cotton.
2. Then we use a moisture regain tester pin and use in this stapes there we put fiber.
3. Then we collect the regain in display and measure the data.

**Data Table:**

|  |  |  |  |
| --- | --- | --- | --- |
| No. of observations | Types of Sample | MR% | Average MR% |
|  |  |  |  |
|  |  |
|  |  |

**Result:**

Average MR%:

**Comment/conclusion:**



**Daffodil International University
Department of Textile Engineering**

**Course Code: TE 231**

**Course Title: Textile Testing and Quality Control – I**

**Experiment no:** 09

**Experiment name:** Determination of moisture regain of Polyester by Moisture Regain Tester (MR%).

**Objective:**

1. To determine the moisture regain of Polyester.

2. To know about working principles of moisture regain tester.

3. To know standard moisture regain of Polyester.

4. To write a short report basis on this experiment.

**Theory:**

Moisture regain is defined as the percentage of water present in a material of woven dry weight.

the percentage of moisture in a textile material brought into equilibrium with a standard atmosphere after partial drying   as a percentage of a moisture a free- weight.

Let,

Oven dry weight = D

Weight of water = W

Moisture regain = MR

MR = 100W / D %

Standard Moisture regain: Standard moisture regain for cotton fibre is about 8.5%.

Testing condition of lab : Temperature maintain in laboratory is about 25 deg C and RH is about 74%

**Atmospheric condition:**

RH(%) =

Temperature =

**Apparatus:**

Moisture Regain Tester, Polyester Fabric

**Machine diagram:**

**Working procedure:**

1. At first we collect a tester fiber as Polyester.
2. Then we use a moisture regain tester pin and use in this stapes there we put fiber.
3. Then we collect the regain in display and measure the data.

**Data Table:**

Direct Count

|  |  |  |  |
| --- | --- | --- | --- |
| No. of observations | Types of Sample | MR% | Average MR% |
|  |  |  |  |
|  |  |
|  |  |

**Result:**

Average MR%:

**Comment/conclusion:**

**Experiment no:** 10

**Experiment name: Determination of amount of twist (TPM) by Shirley Twist Tester.**