

TERMS AND DEFINITIONS OF YARN STRENGTH

8/02/2015

1. Load :- The application of a load to a specimen in its axial direction causes a tension to be developed in a specimen. The load is usually expressed in gms wt. or pounds wt gravitational unit of loads.

2. Breaking load :- This is the load at which the specimen breaks usually expressed as gms wt or pounds wt.

$$\therefore \text{Stress} = \frac{\text{Force applied}}{\text{Cross sectional area in specimen}}$$

Stress is the ratio b/w the force applied and cross section of specimen.

3. Mass stress :- The linear density may be expressed in denier, Tex or count and the mass stress then become the ratio of force applied to the linear density (mass / unit length).

$$\therefore \text{mass stress} = \frac{\text{Force applied}}{\text{Linear density}}$$

4. Breaking stress :- The breaking length is the length of the specimen which will just break under its own weight hung vertically.

5. Strain :- It is the term used to relate the stretch or elongation to the initial length.

$$\text{Strain} = \frac{\text{Elongation}}{\text{Initial length}}$$

68. Yield point :- A yield point is the level at which the specimen (block) to behave elastically. The divided the strain is no longer constant the point at which the occur is known as yield point.

77. Young's modulus :- Stress is proportional to load and strain is proportional deformation as expressed in Hooke's law.

$$E = \frac{\text{Stress}}{\text{Strain}} \quad \text{where } E = \text{Young's modulus}$$

88. Work of rupture :- This is a measure of toughness of the material it is the energy or work required to break specimen.

YARN STRENGTH

8/07/2015
60/1065
after 2 days

1. What are the factors affecting yarn strength?

→ There are various factors that have to be considered which will influence the strength depends upon "fibre properties", i.e., fibre length, fibre fineness, fibre strength and Trash content and also TPI. The other main factor which affects strength is if any chemical treatment given to the yarn before or after manufacturing because these chemicals may cause tender the material and looses its strength.

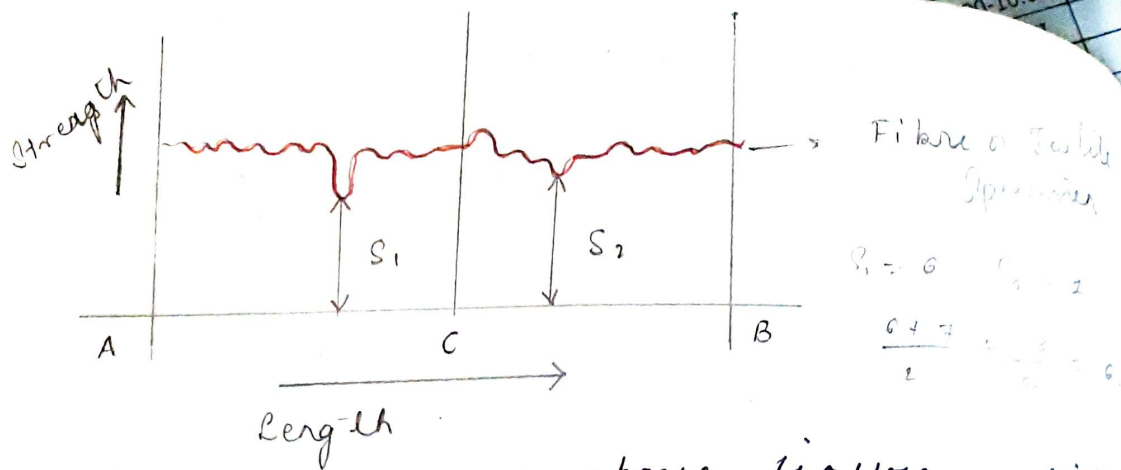
2. What are the factors affecting the tensile properties of textile and the results obtained from the testing instruments.

What are the factors affecting on strength from the tensile testing instrument.

- Length of the test specimen
- The rate of loading and time to break the specimen.
- The capacity of the m/c.
- The previous history of the specimen.
- The effect of humidity and Temp.
- The form of specimen (ie twist or untwisted)

3. Explain length of the test specimen in the tensile properties when results in the testing instrument.

Explain weak link effect or Theory of Strength.



considering the above figure which shows length of material tested for breaking load of the specimen at different Gauge Length of the material in test at the longer gauge length AB. The strength recorded could be the strength of weakest point and value be S_1 of the material is tested in to two halves (Half of the portion) of AC and CB. The breaking load S_1 & S_2 is obtained mean of which $S_1 + S_2 \div 2 = \frac{S_1 + S_2}{2}$ could be higher than S_1 . Hence by testing the given specimen at shorter Gauge length the yield strength increases. As the test length increases "probability" of weak points more. The above mean such strength is not the true value of the material. This is called "size effect".

V. Imp

→ Rate of loading and time to break of Specimen.

→ The rapid strength test adopted in testing tensile strength obtain higher breaking load than a slow test.

The rate of loading is determined by the time to break in the time interval beginning of the application of the load and at the end of the rupture of the yarn.

CAPACITY OF TEST SPECIMEN

If a specimen is tested on high capacity m/c time to break will be short and therefore result will be obtained on the capacity of the m/c should be chosen. So that time required to break the specimen is closed to capacity recommended and time.

Affect of Humidity and Temperature.

The mechanical behaviour of various textile fibre is influenced by the amount of moisture in the specimen. The moisture relationship of various fibre having different and its physical properties will be changed. Hence standard atmospheric condition in the laboratory RH: 65 ± 2 & Temp 27 ± 2 .

PREVIOUS HISTORY OF SPECIMEN

Material undergoes various forms of stress and strain during processing. Effective loading and unloading at different levels behavior of the specimen after it has been strained.

When at the Relaxation point point is different and also if any treatment which affects the tensile strength of the Specimen.

The form of the Specimen :- In many test under different testing instruments Specimens taken for testing will be different forms for example yarn strength can be conducted in two ways in the form of single yarn or Group of yarn (lea strength test). In the same way single fibre and bundle of fibre, strength can be tested on Instron and Stelometer (Bundle). (Single)

Principles of Tensile strength m/c's.
Explain CRE, CRT, CRL OR Explain with a neat sketch principles of applying load to yarn testing m/c. All the instruments for determining the tensile strength of yarns are classified into three groups, based on their principle of working.

→ CRE Constant Rate Elongation
In this section of the fibre strength yarn strength it has been discussed 3 ways of applying the load to the test Specimen namely.

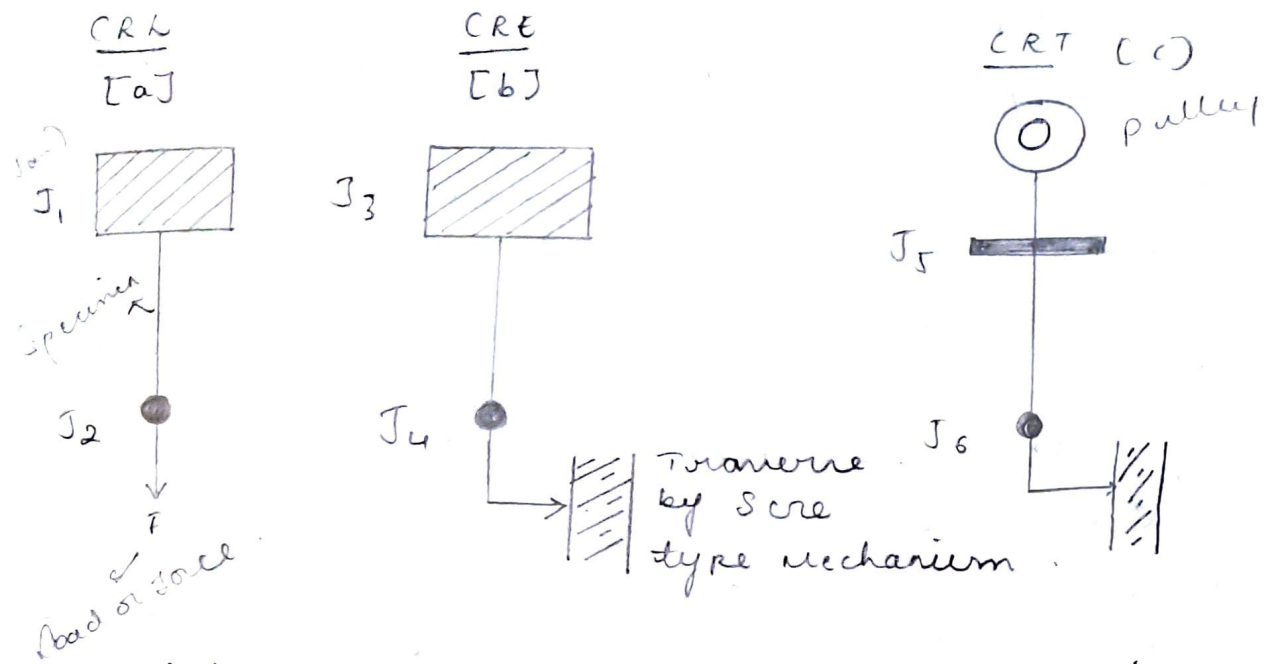
i. CRL :- Constant Rate of Loading.

Ex:- Scott Inclined plane Tester and Webster dynamometer.

ii. CRE :- constant rate of Elongation
Ex:- Instron (Universal Tensile Tester).

card ester Tens rapid Tester.

iii) CRT:- constant rate of Transverse
Ex:- Lea & Single yarn strength tester



consider above 3 identical specimen fig 'a', 'b' & 'c'.

CRL:- constant rate of loading [a].

The ends of the test specimen in fig [a] are mounted respectively in a fixed jaw J_1 and another end fixed to the movable jaw J_2 . A gradual increasing force or load (F) starting from zero increasing at constant rate is applied to the specimen. The applied force causes the specimen to extend until it breaks. In this case, the loading causes elongation. Since load on specimen increases at a constant rate? This principle of loading is called a constant rate of loading.

CRE [b]:- constant rate of elongation.
In figure (b) its ends mounted

respectively, i.e. T_3 is fixed jaw
 T_4 is movable jaw. Then moves
downwards at a constant rate
speed by a screw mechanism as
shown in above figure. The intension
in the specimen is zero when
the bottom jaw moves down
the specimen suffers from extension and
this would cause loaded with downward
force. The tension in the specimen
could go on increasing until specimen
breaks. "In this case, the applied
elongation is responsible for the
or loading on the specimen." This principle
of loading is known as CRE.

iii: CRT [CT]: constant rate of transverse
In fig 'c' is fixed exactly like specimen
'b' but b/w jaw T_5 & T_6 , the upper jaw
is not truly fixed. As in the above
case but due to an instrument design
and features is connected to a pulley
at the top to operate a load cell
mechanism. The lower jaw transverse
downward at a constant rate to
elongation then specimen exactly
like T_4 . The movement of the upper
jaw relative to that of lower jaw
prevents the extension of specimen at
a precisely constant rate. This
principle of loading is referred as CRT.

Exp lain with a neat sketch geometrical configuration of Lea's strength Tester or

(C) Explain Lea's strength Tester.

[Refer TT Record].

Explain with neat sketch
Lea's strength Tester
with C.R. & lower position.
Refer TT Record.

A - Specimen

B - Steel tape

C - Small pulley

D - Screw mechanism (Transverse).

E - Pivot

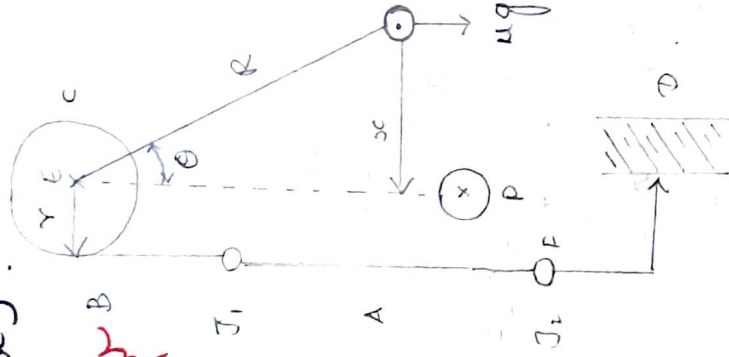
F - Force

P - Pendulum

$mg \rightarrow$ Mass of pendulum

$J_1 \rightarrow$ upper Tans

$J_2 \rightarrow$ lower Tans



$r =$ radius of small pulley.

$\theta =$ Angle through which pendulum moves

$$F \times r = mg \times x = mg R \sin \theta$$

Since, $mg \times R$ and r constant

we can, Substitute by constant K .

$$\left[\frac{mg R}{r} \right] \therefore F = K \sin \theta$$

$$F \propto \sin \theta$$

The upper Tans J_1 is attached to a steel tape which runs over a small pulley radius ' r '. The lower Tans J_2 is given a constant rate of traverse in a downward direction with the help of screw mechanism. The small pulley is pulled round rings the pendulum from its vertical position. Let the mass pendulum be the ' mg ' and its centre of gravity at a distance ' R ' from the pivot of the small pulley.

when the angle through which pendulum has moved 'O' radians. Taking moment about the pivot of the small pulley force is always directly proportional to $\sin \theta$. This has been shown in above figure.

Define overthrow effect or overthrow error.

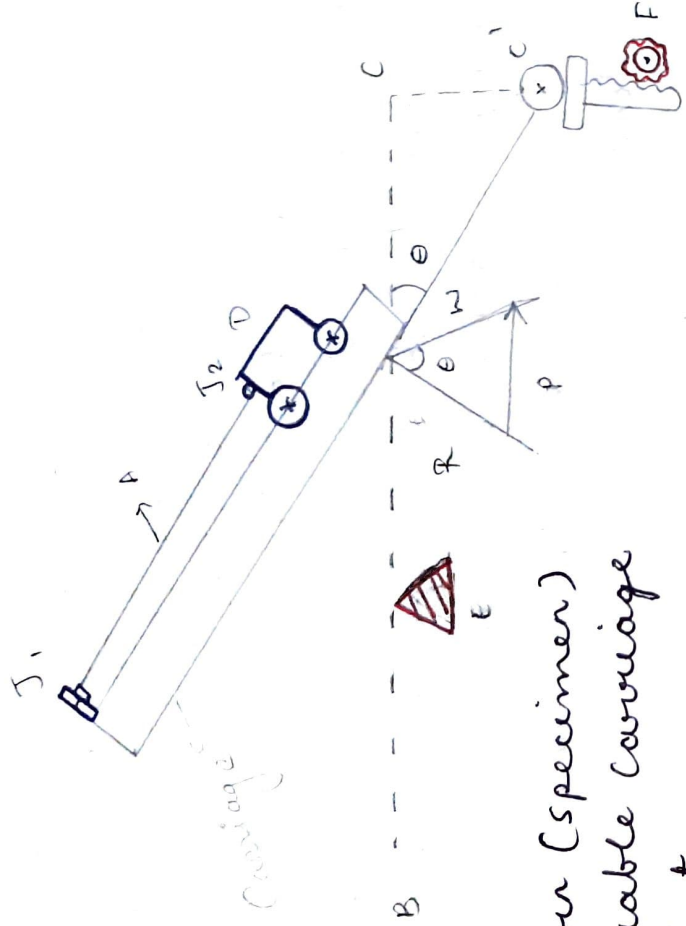
→ When the Specimen breaks, the pendulum will have angular velocity depend upon rate of traverse of bottom jaw on extension of Specimen. The pendulum success $K \cdot E$ and will continue to move until all the energy has been dissipated with the results zero. The cm/c shows higher breaking load. This excessive load depending upon angular velocity of the pendulum. The moment of break, the cover throw error greater for small to small error will be there. Therefore reduce this error by having a low rate of traverse.

Define acceleration error or define effect of acceleration in CRT principle.

→ The initial force required to move the pendulum is greater than the th required force to move the pendulum moving. To keep the pendulum moving required angular velocity. Hence there will be tendency for pendulum to accelerate the tension in the Specimen; reduces results and its slackness.

Explain with a neat sketch Scott's method of plane instrument. OR Explain with a neat IP Instrument.

Explain with a neat sketch any inclined plane CRK principle. 10/7/2015



A → Yarn (Specimen)

D → Movable Carriage

E → Pivot

J₁ → Fixed Jaw

J₂ → Movable Jaw

B, C → plane line

$$P = W \sin \theta$$

$$P \propto \sin \theta$$

Now consider $\Delta E C C'$

$$\sin \theta = \frac{C C'}{E C}$$

Above fig works on the principle of CRK (Constant rate of loading). A in yarn sample (specimen) is clamped b/w a fixed Jaw J₁ and movable Jaw J₂. Jaw J₁ is fixed to a plane rail 'B C' and Jaw J₂ is fixed to a freely movable Carriage 'D'. The plane pivoted at 'E' and lower its right end can therefore tilt it, the left end of the rail is linked to make and pinion drive 'F', which is driven by a motor.

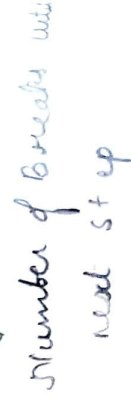
At the start of the test the plane is horizontal (B C) and its right end at C, when the way is set in the motion. The end 'C' descends to a position C'. Let the way swing or tilt through an angle 'α'. When its right end moves

from position C' to C . The incline
 where the cord from the horizontal. Let
 has the weight of the carriage acting
 cable. The force 'P' acting
 for the yarn specimen can be calculated
 Sin Resolving the vertical force W into
 big direction: one $W \sin \theta$ plane (BC) and
 \perp to it: $W \cos \theta$ is the force $W \cos \theta$ to the
 Def: Force applied to the specimen
 $\rightarrow W$ the carriage inclined plane.
 Then $P = W \sin \theta$.
 one: $P \propto \sin \theta$
 the specimen is directly proportional
 $\sin \theta$. Now, consider the $\Delta E C C'$,
 $\sin \theta = \frac{\text{side}}{\text{Base}}$ or $\frac{C C'}{E C}$
 If $\sin \theta$ increased
 P constant rate the load on the spec
 can be increased at a constant rate
 This is easily achieved by increasing
 or at a constant rate.

Q.L.O

single with a dynamo.

July 5



E → Carriage and

→ Genom: kod Mechan

100

$I \rightarrow \text{Top Panel}$

1. 0.0001

turnment "chattel"

and then

homology: \mathbb{Z}

1

entertainment

3

100

panels in the instrument is inclined plane mechanism [I], middle panel [H] and bottom panel [J].

The top panel [I] consists of a inclined plane mechanism as provided. This consists of screw rod [G] which inclines the plane and rolling carriage which rolls over the plane. The capacity of the instrument can be change 0-2000 gms.

The middle panel [H] consists of the top chart records individual Breaking load of test Specimen. 1114 bottom chart elongation for individual test Specimen.

An interesting feature of this instrument of the bottom panel [J] this panel consists of a grid in which steel balls form a frequency distribution diagram of the breaking load of the test Specimen.

TEST PROCEDURE

* There are 10 Spinning cops placed on a reel. Free ends of the yarn threads to the guide and automatically test carried out one after the other.

Instrument automatically pickup the yarn from lower jaw T₂ and then through upper jaw T₁. The test Specimen is then clamped at its two ends. Next, the right end of the plane and the carriage unit is beginning to roll down due to inclined plane [F].

The action imposed constantly increases load on this test specimen, causing it to extend at the set up point and load keep on increasing directly proportional to inclination of the plane [or] and movement of carriage. Finally the specimen breaks.

The breaking load of the test specimen is recorded by carrying steel ball to be dropped on a appropriate column of the breaking load frequency distribution.

What are the special features of the Suga Yarn Tester or ultra dynamic meter.

Advantages

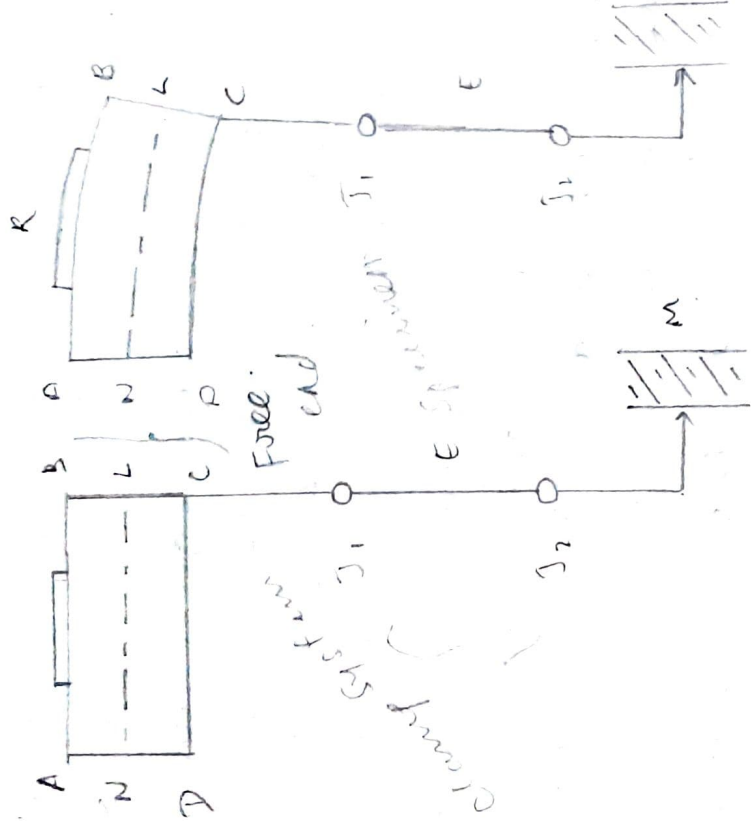
- * The Gauge length normally used in this experiment is 500 mm or 50 cm.
- * A magnetic tension disk is used for preset tension 0.5 gm / tex
- * In this instrument ^[single yarn is measured expressed in gm] graph chart represents for load and elongation
- * The breaking load frequency distribution has been provided
- * Maximum number of Cops can be arranged on the reel and all the test can be carried out one after the other.

All the test results are displayed in the display board at the center panel.

Q) Explain the STRAIN GAUGE PRINCIPLE (CCE)

1) Explain with a neat sketch the strain gauge principle.

15/07/2019



Wheat stone
Bridge

ABCD = Beam

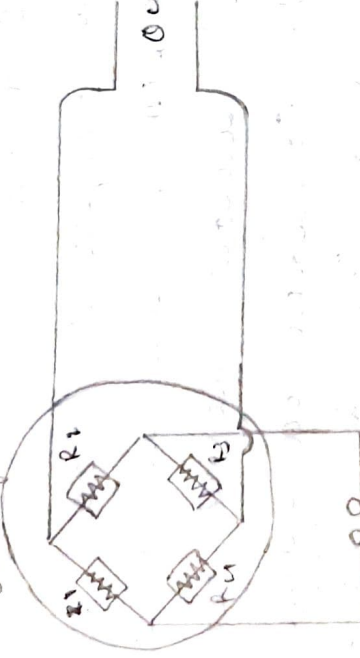
E = Specimen

J₁ = Upper Jaw

J₂ = Bottom Jaw

M = Screw Mechanism

R = Resistance wire



The strain Gauge principle is relatively and more recently very extensively used in textile testing lab. This technique well known that "wheat stone Bridge principle".

A beam "ABCD" which is actually a flat stiff screen is mounted like a cantilever support it can shown in above fig. (one end fix other end free). The beam is connected to an upper Jaw J₁, at which clamped one end of test specimen. The other end of the test specimen is clamped at lower Jaw J₂, which can

be caused to traverse vertically down by means of screw mechanism of T_2 moves down & tensile force is developed in the spring and this cause the free end of the beam ABC to be deflected. If a resistance wire 'R' were fixed to upper face AB of the beam. The effect of deflection of beam will be transmitted to it [R], such that to measure the magnitude of the load on the spring.

When the beam ABC is in the length of the upper face AB increases in length and length of lower face CD decreases. This change in length be proportional to the applied load b/w two outer faces AB & CD . There is a neutral plane (centre line NC) whose length remains unchanged (negligible). Consider a wire [R] firmly mounted b/w AB of the beam. So that the elongation of AB will be produced, of R . There is a load applied on end BC causes a change in

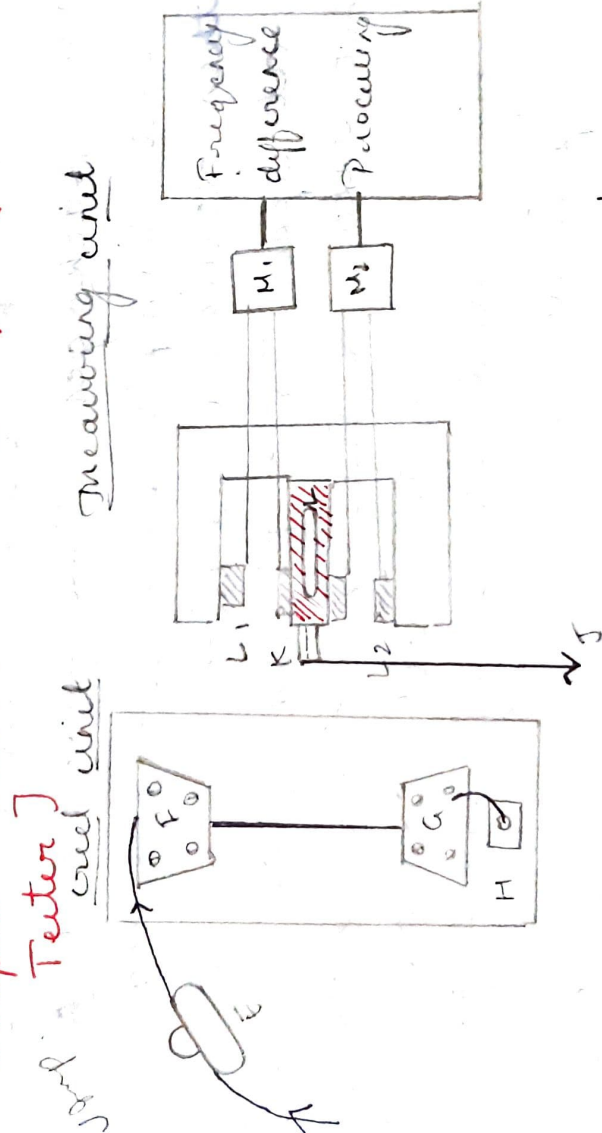
the length of resistance wire. The change in volume of the resistance is directly proportional to the magnitude of the load (direction).

The interconnections b/w the 4 resistance $[R_1, R_2, R_3, R_4]$ in Wheatstone bridge is as shown in above figure. All the resistance are equal when no strain on the beam.

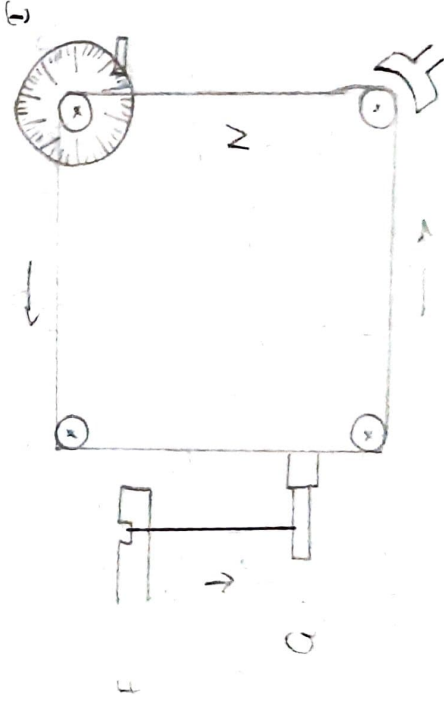
When Beam suffers a strain over the changes in the resistance of the specimen. This in turn could lower the output voltage across 'CD'. This voltage drop proportional to the load applied to the specimen. This output electronically processed and recorded automatically visible information.

Uster TensO RAPID INSTRUMENT [CRE]

Explain with a neat sketch inter Tensio wrapped environment. [single your strength Tester]



A - jaws
 E - Tensioner
 F - Upper Jaw
 G - Lower Jaw
 K - Beam
 L, L₁ - Pins
 m, m₁ - oscillators
 H - Section Hole
 K - Pin
 T - Jaw or force



F → upper Jaw
G → lower Jaw
I → Dile
N → chin

Kollektion: Unter

The water Tensile craped instrument is used to determine the breaking load and breaking elongation of the specimen.

Principle:- The instrument working under the principle CRE

Construction:- There are 3 major units as shown in above figure.

1. Creel unit
2. measuring unit
3. Elongation unit

CREEL UNIT:- The creel consists of 4 hold yarn packages. The yarn ends from the test sample is passed through guides then tensioner device 'E' and clamped at upper jaw 'F' and bottom jaw. Finally let into a suction circle hole.

The instrument comes with different sizes and types of jaw for different specimen.

For example:- single yarn, plied yarn, knitted yarn and also for fabric Testing.

Measuring Unit:- Breaking force (load) measurement is a pin (K) is connected to the [K], Fixed at one end and other end is free (cantilever support). There are two sensors L_1 & L_2 . L_1 at the top of and L_2 at the bottom of the beam. Spacing b/w two sensors is equal. The beam L is horizontal. The sensors are connected to oscillators $[m_1, m_2]$. Force [F] is applied.

the beam "so that space b/w Top sensor increases and space b/w Bottom sensor decreases". As a result the two oscillators $[M_1, M_2]$ differ in frequency which give measure of force "I". The frequency difference is fed to signal processor to convert it force required to break the Specimen.

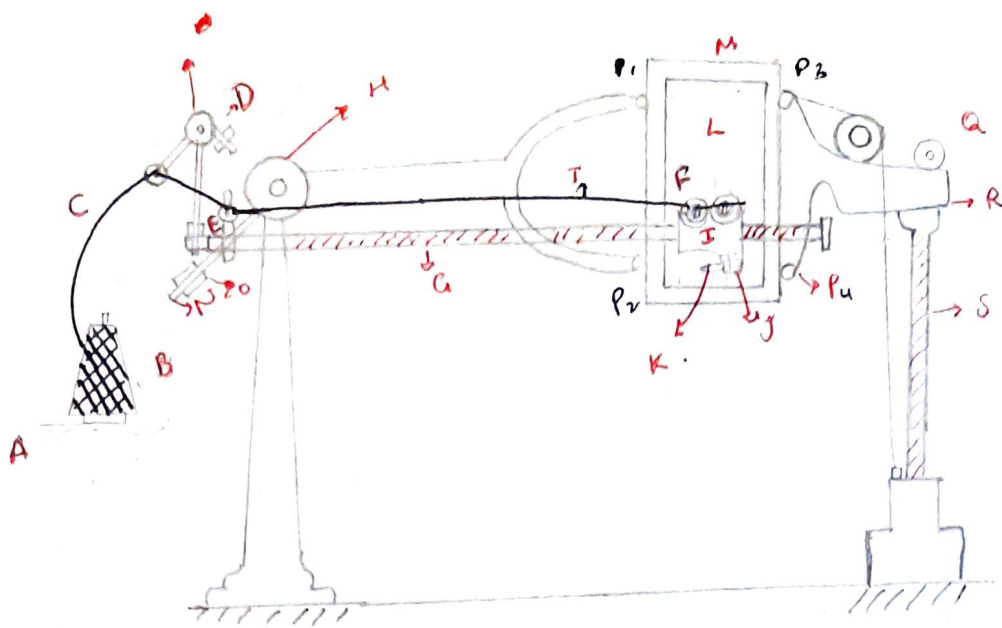
ELONGATION UNIT :- As the movable Jaw moves in a elongation measurement unit. The chain 'N' also moves and turns the disk 'I', Around the circumference of the disk 1000 evenly distributed marking. When the chain moves marking on the disk measured optically to produce impulses. These impulses are converted to determine the elongation of test Specimen.

TEST PROCEDURE :- The breaking force and elongation values of all of the samples tested and converted into electrical signals and transmitted to the signal processor which converts the information into the reportable data and stores them.

Explain with a neat sketch Scott Scoringograph
16/10/2015

Description of the Instrument

The instrument consists of C-clamp 'A' to hold the test specimen B. The tension device 'C' consisting of a dead weight lever arrangement 'D' can be adjusted to apply a fixed pre-tension to the test specimen. A fixed Jaw 'E'



A → Creel
B → Yarn package
C → Tension device
D → Read weight & lever arrangement
E → Fixed Jaw
F → Movable Jaw
G → Rail
H → Fulcrum
R → Platform
Q → Roller

I → Trolley
J → Additional weights
K → Pen
L → Graph paper
M → Chart holder
N → balanced rod
O → balanced weight
P → Guide Pulley
S → Screw mechanism
T → Specimen

It is attached to one end of long rail. The fixed Jaw can be adjusted to any desired length. The rail can move about fulcrum 'H'. The rail is graduated upto 500 mm (50 cm) Gauge length.

Another Jaw 'F' is attached to a carriage or trolley 'I' that can roll freely on the rail. A Pen 'K' can be attached to carriage. During test the pen can trace the load, elongation curve on graph paper 'L'. The chart holder 'M' is fixed to a balance rod 'N' and balance weight 'O'. Four Guide

pulley $P(P_1, P_2, P_3, P_4)$ manipulate the chart work hold.

TEST PROCEDURE

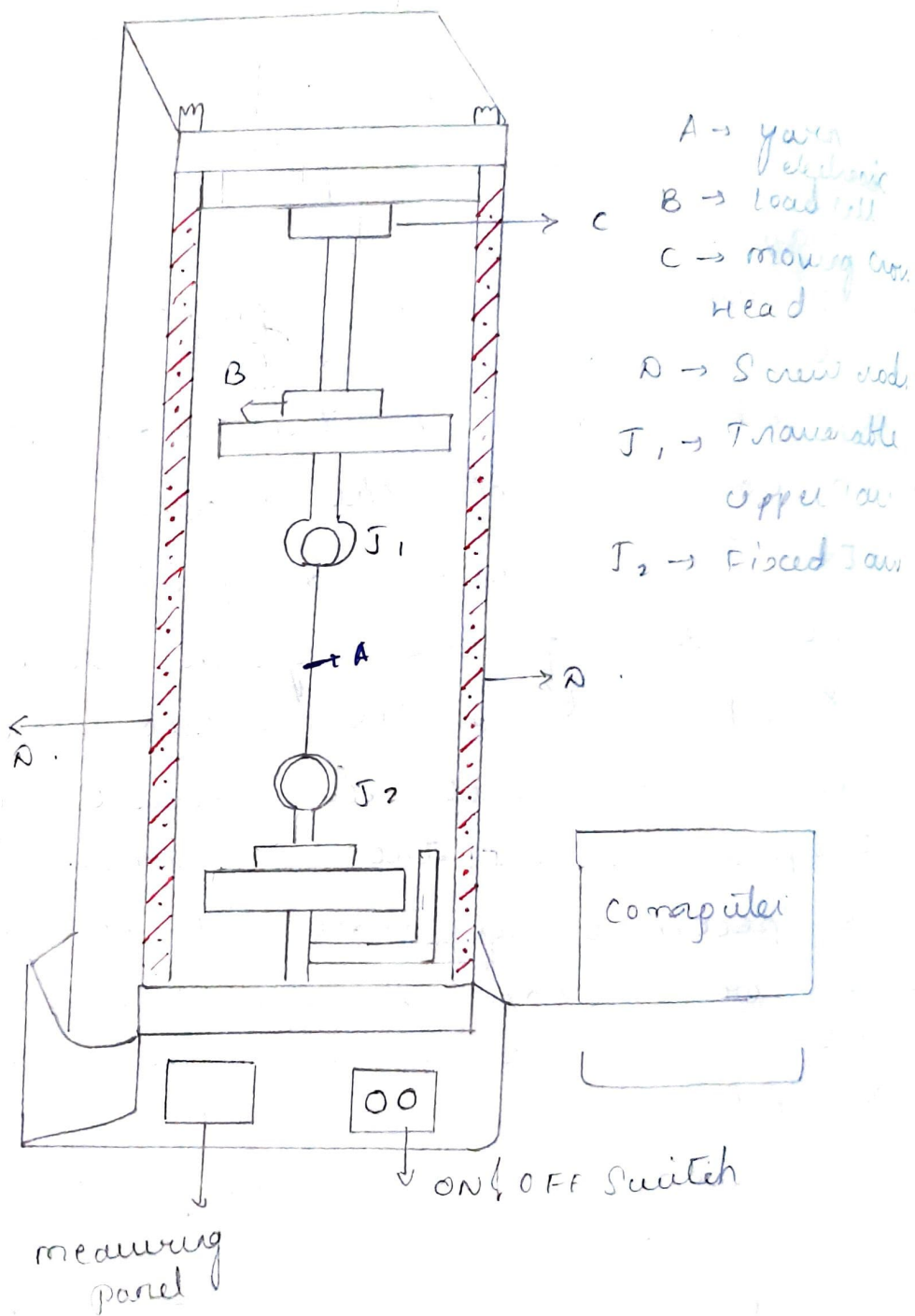
- * The left hand Jaw is positioned and fixed on the rail.
- * The Dead weight arrangement made for yarn pre-tension.
- * Pen is placed at pen holder of the carriage.
- * Insert the fresh chart paper in the chart holder.
- * Set the rail in the horizontal position.
- * Fix one end of the yarn in the fixed Jaw and clamp it.
- * other end of the yarn via Tension disk, pull it until tension disk, until tension disk unit is vertical and clamp the Specimen to the movable Jaw.
- * The Specimen is now set for the test.
- * The Screw rod is now loosened, The rail start inclining Thus, Load is applied on to the yarn. (until it breaks)
- * Pen records the curve on the paper.
- * The Screw drive is reversed to raise the rail back to its horizontal position.
- * The above procedure is repeated for another ^{to line} test.

$$RKM = \frac{\text{Breaking Load in gms}}{\text{Yarn Count in tex.}}$$

RKM = Rupture in Kilometer.

INSTRON INSTRUMENT (CRE PRINCIPLE)

Explain with a neat sketch working of Instron instrument. (Universal Instron Test)



PRINCIPLE :- This instrument works on strain gauge principle (CRE). The specimen is clamped b/w a transverse upper Jaw T₁ and fixed lower Jaw T₂. The upper Jaw is traversed at a constant speed to extend the specimen.

This cause a load to develop in the Specimen. The load is transmitted to the resistance wire in a load cell. The change in the load cell are depending upon strength of the Specimen.

DESCRIPTION :- A typical Instron tensile tester is shown in above figure. 'T₁' is a traversible upper Jaw and 'T₂' is lower fixed Jaw. 'A' is the yarn test is clamped in a moving cross head 'C' that can be traversed along Screw rod 'D' located in the side column of the instrument. The upper Jaw is attached to the load cell. The capacity of the load cell range from 0-50 gms. (single or group of fibres for yarn) & 0-500 kgs for very strong material. With respect to Specimen and load cell also clamps for hold the Specimen has been suitable changes which is supplied ~~for~~^{by} the instrument.

WORKING :- The correct load cell and Jaws are selected according to the test material. The required Gauge length are selected on the main panel of the instrument.

The yarn Specimen is mounted in b/w two Jaws and the cross head is traversed. The upper Jaw moves up and Specimen is

elongated. This elongation causes changes in the resistance of the load cell. The electronic pulser converts the output data in a digital manner and also draws a chart of load and elongation.

GIVE THE FEATURES OF THIS INSTRUMENT
OR AI

- It is a universal tester because test can be made single fibre to yarn, fabric and high tenacity fabric.
- Load cell range can be provided for different test in order to give accurate test results.
- All test results are displayed in computer observed chart of elongation and load curves, average and single break values of the specimen.
- In this instrument various tests are possible. Example :- Load and elongation, compression test, fabric tearing strength and etc.

(14) BALSTEC STRENGTH TESTER
OR IMPACT PRINCIPLE OF YARN TEST

Explain with a neat sketch Ballistic Strength Tester.

In this principle, the energy or work measured at break the specimen is measured. The energy known as work of rupture consists of yarn specimen is