**FOREST PRODUCT DEVELOPMENT LABORATORY PROCEDURES**

**Standard operating procedure on determination of Total Ash in Plant Samples**

**1. Title:** Standard operating procedure for Determination of Total Ash Content

**2. Scope:** The method is applicable to plant samples.

**3. Purpose:** The purpose of this procedure is to determine the inorganic content of the plant samples

**4. Terms, Acronyms and Definitions:**

1. Ash content: is a measure of the total amount of minerals present within the plant material. Ash is the inorganic residues remaining after the water and organic matter have been removed by heating.

**5. Apparatus/equipment**

1. Spatula
2. Crucible
3. Desiccator
4. Analytical balance
5. Muffle furnace

**6. Materials**

1. Dry plant samples

**7. Procedure:**

* 1. Heat a porcelain crucible at approximately 600 ºC during one hour, cool it in desiccator, weigh and record the weight as (a).
  2. Weigh 5.000 g of dry plant material (ground to pass a 1 mm mesh sieve), into10 ml porcelain crucible and record the weight as (b).
  3. Increase the temperature of the muffle furnace to 600 ºC and maintain this temperature for 2 hours until a whitish grey ash remains. Do not open the door of the furnace during the ashing.
  4. Place the crucible in a desiccator, allow it to cool and weigh as (c).
  5. Calculate the ash content is using the below formula. The total ash content equals the weight of the ash divided by the weight of the original sample multiplied by 100%, as expressed in the formula below. The ash result is expressed as % ash.

**% total Ash = c-a /b-a×100**

Where a= weight of empty crucible

b= weight of dry sample and crucible before ashing

c= weight of dry sample and crucible after ashing

**8. References.**

1. Kenji G.M &Karanja P.N., (2009): 1st draft edition, analysis of foods practical manual, JKUAT, pp. 38-42.
2. E1534 - 93(2013) Standard Test Method for Determination of AshContent of Particulate Wood Fuels , ash, biomass, wood fuel,
3. <http://people.umass.edu/~mcclemen/581> .Ash&Minerals.htmlAnalysis of Ash and Minerals. Searched on 6th march 2012

**Standard Operating Procedure for Bamboo Treatment**

**1. Title:** Standard operating procedure for bamboo preservation.

**2. Scope**: The method applies to treatment of mature bamboo culm samples.

**3. Purpose**: The purpose of this procedure is to preserve bamboo culms for construction against insect/fungal attacks

1. **Terms, Acronyms and Definitions:**
2. Bamboo culms: Culm in botanical context refers to a stem of a plant. It is derived from the Latin word ‘stalk’ (*culmus*).

**5. Apparatus/equipment**

1. Weighing balance
2. Spatula
3. Measuring cylinder
4. Treatment tank
5. Gloves
6. Nose masks
7. Beaker
8. Volumetric flask

**6.Reagents/ materials**

1. Borax
2. Boric acid
3. Fire wood
4. Water

**7**. **Procedure:**

* 1. Weigh exactly 1kg of boric acid and mix with 1kg of borax into a 5litre beaker.
  2. Transfer the chemical mixer into a treatment trough and add 38litres of water. This constitutes 5% w/v. of the treatment solution.
  3. Stir thoroughly until it dissolves completely.
  4. Arrange the bamboo culms horizontally in the solution.
  5. Put on the fire beneath the drum and heat at boiling point for 2hours, till a complete penetration is achieved.
  6. Remove the culms from the solution and place them vertically till they dry.

**8. Reference**

1. Bamboo harvesting and preservation training manual(2012)by Gordon Sigu and Samson Mogire

**Standard operating procedure for determination of calorific value in plant samples**

1. **Title:** Standard operating procedure for determination of calorific value in plant samples.
2. **Scope:** The procedure covers evaluation of calorific value in all plant samples.
3. **Purpose:** The purpose of this procedureis to determine amount of energy present in the plant samples.

**4. Terms, Acronyms and Definitions:**

1. Calorific value: The energy contained in a substance determined by measuring the heat produced by complete combustion of a specified quantity of it.

**5. Apparatus/ equipment:**

1. Bomb calorimeter
2. Analytical Weigh balance
3. Oxygen gas.
4. Beckmann thermometers
5. Ignition wire
6. Tissue paper

**6. Materials/reagents:**

1. Benzoic acid tablet
2. Plant samples
3. Distilled water
4. P**rocedure**
   1. Accurately weigh ignition wire, tissue paper and benzoic tablet on analytical weigh balance.
   2. Carefully wrap the tablet with a tissue paper and then tie with the ignition wire.
   3. Place the benzoic acid tablet sample on the sample boat and tie the two ends of ignition wire to the terminals.
   4. Tightly close the bomb and pump oxygen gas until the pressure gauge pointer is at 30kg/cm2.
   5. Fill up the inner cylinder of the calorimeter with 2100ml of distilled water and ensure that its temperature does not register higher than 0.10C on the scale.
   6. Insert the Beckmann’s thermometers in each cylinder.
   7. Adjust the temperature of the outer cylinder by injecting hot or cold water so that the difference between the two cylinders is maintained within the range of ±0.30C.
   8. Stir water in both cylinders for 10 minutes and then ignite the sample.
   9. As the temperature of the inner cylinder start to rise immediately after the combustion of the sample, note the initial readings.
   10. The temperature of the outer cylinder is also noted and hot water added continually to ensure that both temperatures of the inner and outer cylinders rise up together and this will avoid any transfer of heat between the two systems.
   11. The highest temperature is recorded for the inner cylinder.
   12. Repeat the same procedure for the analysis of samples.
   13. Calculate of the calorific value of the plant sample using the formula below

Calorific value=

**H20 equivalent+ (H20 quantity in the inner cylinder \* temperature rise of inner cylinder)-calory correction**

**Weight of sample**

Where, H20 equivalent= Calorific value of benzoic acid \* weight of benzoic acid - H2O quantity of inner cylinder \* Rise in temperature of benzoic acid

Calorific value of benzoic acid = 26.46 kj at 200C

In Kcal 26.46 = 6.3 Kcalg-1

4.2

Calorie correction = (weight of tissue x its calorific value) + (weight of ignition wire x its calorific value)

Where, Calorific value of tissue paper = 3986 Cal g-1

Calorific value of ignition wire = 775 Cal g-1

1. **References**

1. Yoshidaseikakusho, model 1013-B manual (1994)

2. Pauline Ondachi, (2001); Nutritional studies of indigenous fruit trees in support of conservation, pp 13.

**Standard operating procedure for determination of dry matter in plant samples**

**1. Title:** Standard operating procedureto determine dry matter content in plant/ organic samples

**2. Scope:** This method is used to determine the percentage of dry matter in plant samples by drying them to a constant weight.

**3. Purpose:** The purpose of this procedure is todetermine the levels of dry matter in plant samples as it influences their physical and chemical properties.

**4. Terms, Acronyms and Definitions:**

1. Dry matter content: it refers to material remaining after removal of water and the moisture content reflects the amount of water present in the substance. For the purpose of this procedure dry matter content refers to the ratio of the mass of a test sample after drying at a temperature of (1050C± 2), to its mass at the time of sampling.

**5. Apparatus/ equipment:**

1. Oven.
2. Analytical weighing balance
3. Crucible
4. Tongs
5. Desiccator, containing a water absorbing agent
6. Analytical balance, having resolution not less than 0.1 mg.
7. Spatula
8. Pestle and mortar
9. Sieve

**6. Materials**

1. Plant samples
2. **Procedure:**
   1. Weigh crucible on an analytical balance to nearest 0.0001 g (W1).
   2. Place approximately 2 g plant material on the crucible and weigh to the nearest 0.0001 g (W2).
   3. Place the sample on the dish in drying oven set at 105 °C for a minimum 3 hours.
   4. Remove sample on the dish from the oven and place it in a desiccator for 1 hour to cool.
   5. Remove sample from the desiccator and weigh it on balance to the nearest 0.0001 g (W3).
   6. Calculate dry matter content of the plant sample using the formula below. Dry matter content is expressed as a percentage.

**Dry matter content = ((W3 – W1) / (W2 – W1))\*100 (% to the nearest 0.1).**

Where W1= weight of the empty and dry crucible.

W2= weight of the sample and crucible before drying

W3= weight of the sample and crucible after drying

1. **References**
2. www.deldot.gov/information/pubs\_forms/manuals/mat... Method of determination of moisture content searched on 5th march 2015
3. Kenji G.M &Karanja P.N., (2009): 1st draft edition, analysis of foods practical manual, JKUAT, pp. 33-45.

**Standard operating procedure on determination of specific rotation in plant samples**

**1: Title:** Standard operating procedure for determination of specific rotation in plant samples.

**2: Scope:** The method is applicable to all plant samples containing sugar.

**3: Purpose:** The purpose of this procedure is to determine optical purity and identity of the unknown sugar samples by measuring its specific rotation.

**4. Terms, Acronyms and Definitions:**

1. Specific rotation: it is a fundamental property of chiral substances that is expressed as the angle to which the material causes polarized light to rotate at a particular temperature, wavelength and concentration.
2. Dextrorotatory (right turning): these are molecules that shift the angle clockwise. They rotate light clockwise and correspond with positive specific rotation values *d* or (+).
3. Laevorotatory (left –rotating): these are molecules that shift the angle counter-clockwise. They rotate light counterclockwise and correspond to negative values *l* or (-).
4. Polarimeter: is a scientific instrument used to measure the angle of rotation caused by passing polarized light through an optically active substance.

**5. Apparatus/equipment**

1. 50 ml reagent bottles
2. Aluminium foil
3. Wash bottle
4. Filter funnel
5. Lens tissue paper
6. Spatula
7. Pestle and mortar
8. Analytical weigh balance
9. Polarimeter

**6**. **Reagents/ materials**

1. Plant samples
2. Glucose/ sucrose standards
3. Distilled water

**7. Procedure**

* 1. Weigh out accurately 0.5000 g of glucose (calibration standard) and also the samples on aluminum foil.
  2. Carefully transfer the sample into 50mlvolumetric flask and dissolve the material in approximately 10ml of deionised water. Swirl the contents until the entire solid has dissolved.
  3. Wash off the wall of the funnel to ensure a complete transfer of the sample into the flask.
  4. Carefully drop wise add deionized/distilled water to volumetric flask until bottom of meniscus is exactly on line.
  5. The solution in the flask constitutes 1% w/v solution.
  6. Allow the sugar present in the sample to invert by leaving the sample overnight in the volumetric bottle.
  7. Fill the polarimeter cell with the solvent, ensuring that the cell path is clear and the temperature of the solution is maintained at 200C.
  8. Place the cell on the rails inside the instrument and press the “**Zero button**" to zero the instrument. The screen should show 0.000.
  9. Remove the solvent and fill up the cell with the standard solution of glucose making sure that the entire inner part is filled without any air bubbles or particulate matter.
  10. The reading on the display is recorded including the sign (dextrorotatory or laevorotatory).
  11. The cell is taken out and cleaned thoroughly with distilled water.
  12. Calculate specific rotation using the formula below. Specific rotation may be expressed as degrees per mole of the substance where the conditions of measurements (i.e. solvent, light, and source and path length) are also specified.

the specific rotation [α ]Tλ =  αTλ

l.c

Where: T is the measurement temperature (200C); λ is the wavelength of light employed; α is the observed rotation; l is the path length (length of the tube in decimetres (1 dm=10 cm)); c is the concentration in grams per millilitre

**8. References**

1. [**http://www.chem.ucla.edu/~bacher/General/30BL/tips/Polarimetry.html**](http://www.chem.ucla.edu/~bacher/General/30BL/tips/Polarimetry.html) **searched on 04-03-2015**
2. Angelo DePalma(2014)-Polarimetry – Optical Rotation vs. Specific Rotation.
3. Kenji G.M &Karanja P.N., (2009): 1st draft edition, analysis of foods practical manual, JKUAT, pp. 66-72.

**Standard operating procedure on crude fat determination in plant samples**

1. **Title:** Standard operating procedure for crude fat determination in plants
2. **Scope:** The procedure covers analysis of fat in all plant samples.
3. **Purpose:** The purpose of this procedure is to determine amount of fat present in plant samples.
4. **Terms, Acronyms and Definitions:**
5. Crude fat: Crude fat is an estimate of the total fat content of plant material. It is estimated using ether or hexane extraction. Crude fat contains true fat (triglycerides) as well as alcohols, terpenes, pigments, ester and other lipids.
6. Allihn condenser: consists of a long glass tube with a water jacket. A series of bulbs on the tube increase the surface area upon which the vapor constitutes may condense.

**5. Apparatus/equipment**

1. Soxhlet extractor,
2. Allihn condenser,
3. Rubber tubing,
4. Round-bottomed flask with ground glass joint per 1000 ml,
5. Glass bottle with ground glass joint per 500 cm3,
6. Heating mantle,
7. Laboratory stand,
8. Condenser clamp + clamps holder,
9. Cellulose thimble,
10. Fat-free cellulose wool,
11. Glass beads,
12. Mortar and pestle
13. Analytical balance
14. Laboratory spoons,
15. Round-bottom flask support,

**6. Reagent**

1. n- hexane or ( 40-60)0C petroleum ether)

**7. Procedure**

* 1. Weigh 5 g (±1 mg) of prepared sample on analytical balance,( *m*0 ) and transfer it quantitatively to the cellulose thimble (remains of sample should be wipe off with the cellulose wool and transfer into the thimble)
  2. Plug the thimble with fat-free cellulose wool. The thimble should be filled maximally to the three-fourths full.
  3. Place the flask in the heating mantle and pour carefully about 350 ml of *n*-hexane or petroleum ether. Join the Soxhlet extractor with the flask. Place the thimble with the sample into the chamber of the extractor.
  4. Join the condenser with the extractor. Join the rubber tubing with the condenser – cooling water should enter through the lower fitting and exit through the upper fitting. Verify the correctness of the connections of apparatus.
  5. Turn on the cooling water flow and begin heating the flask with a mantle.
  6. Extract the sample for 8 hours to collect the extract in *n*-hexane or petroleum ether.
  7. Adjust heat as necessary to achieve about 10 extraction cycles per hour.
  8. After completed extraction (about 40 minutes before the end of the experiment) open a stopcock at the bottom of the extraction chamber and distill out the whole solvent from the extracted lipid to the glass bottle with ground glass joint.
  9. Evaporate all the solvent from the extract.
  10. Cool the extract and weigh (m2).
  11. Calculate total fat content *H*, expressed in grams per 100 g of sample (or in percentage) using the below formulae:

**% H = m2-m1\* 100**

**m0**

Where,

*m*0 – is the initial mass (g) of the crude sample,

*m*1 – is the mass (g) of the extraction flask

*m*2 – is the mass (g) of the extraction flask containing the extract

**8. References**

International Standard ISO 6492:1999 Animal feeding stuffs – Determination of fat content.

1. International Standard ISO 659:2009 Oilseeds – Determination of oil content (Reference method).
2. Kenji G.M &Karanja P.N., (2009): 1st draft edition, analysis of foods practical manual, JKUAT, pp. 4549.

**Standard operating procedure for sample wood sample collection for identification**

1. **Title:** Standard operating procedure for wood sample collection for identification

**2**. **Scope:** The method is applicable to all tree species

**3**.  **Purpose:** The purpose of this is tocollect tree species for identification

1. **Terms, Acronyms and Definitions:**
2. Xylarium- A display of identified wood specimens or collections intended for scientific research, teaching or environmental education

**5. Apparatus/equipment**

1. Power saw
2. Knife/Panga
3. Newspaper pages
4. **Reagents**
5. Ethanol
6. Clear varnish
7. **Procedure**
   1. Select the smallest tree among the tall ones.
   2. If the tree is not tall harvest the branches.
   3. Cut the smallest tree by use of the power saw.
   4. Select one of the branches and cut 1metre log of 4 inches diameter.
   5. Harvest the leaves and flowers from the small branches using a knife or panga.
   6. Spray them with ethanol and place them between two newspapers and let dry at room temperature so that they retain the green color after drying.
   7. Make sure they have dried well.
   8. Remove them from the newspaper pages and keep them in the xylarium.
   9. Apply the clear varnish to prevent infestation by insects and fungus.
   10. Follow the same procedure for seeds and flowers.
   11. The above collected samples are transported to the laboratory for analysis.
8. **Reference.**
9. A.A. Oteng-Amoako (2006): 100 tropical African timber trees from Ghana.
10. A.J. Panshin and Carl Zeeuw (1970) text book of wood technology
11. E.A. Wheeler, P. Bass and P.E., Gasson (1989): Iawa list of microscopic features for hand identification.

**Standard operating procedure for wood identification.**

**1.Title**: Standard operating procedure for wood identification

**2**. **Scope**: The method covers all wood and tree species

**3**. **Purpose**: The purpose of this procedure is to identify wood and tree species

1. **Terms, Acronyms and Definitions:**
2. Safranin: It is a biological stain used in histology and cytology. It is used as a counterstain in some staining protocols, coloring all cell nuclei red. It can also be used for detection of cartilage, mucin and mast cell granules.
3. Microtome: is a tool used to cut extremely thin slices of material. Used in microscopy allowing preparation of samples for observation under transmitted light or electron radiation.
4. Macerate: to make soft by soaking or steeping in liquid.

**5. Apparatus /equipment**

1. Microtome
2. Photomicrographs system
3. Camera
4. Microscope
5. Microtome knife
6. Slides
7. Petri dishes
8. Magnifying lens
9. Pencils
10. Plastic and glass Beakers

**6. Reagents**

1. Distilled water
2. Xylene
3. Absolute ethanol
4. Acetic acid
5. Hydrofluoric acid
6. Hydrogen peroxide
7. Stain
8. Safranine
9. DPX mountant

**7. Procedure**

* 1. Wood samples are cut into small blocks of approximately 1cm by1cm by 1cm with faces carefully oriented in transverse, radial and longitudinal or tangential direction.
  2. The blocks are labeled accordingly using pencil and put into polythene bags independently to avoid mixing.
  3. Sand paper is used to clear off loose fibers on the wood blocks.
  4. Soft wood blocks are softened by putting them into the beaker with water and boiling until they sink on their own weight
  5. For hardwood , two types of treatments can be used for softening as follows:

1. Place the wood blocks in the hydrofluoric acid in plastic/Teflon beakers for 2 hours and cut with a sharp knife or scalpel blade and the cutting will best indicate when the block is ready for sectioning. Wash the blocks in water thoroughly till they are acid free to ascertain that there are no traces of acid use litmus paper to test the solution.
2. Take equal parts of acetic acid and 30-50% hydrogen peroxide and put into flask fitted with reflux condenser. Put the blocks in to the solution and leave for one hour (if allowed to stand for longer it will macerate)
   1. Remove the blocks and wash in sufficient running water to remove all traces acid.
   2. For sectioning, cut three sections each of them between 10µm and 20 µm thickness from every wood block i.e. radial, tangential and transverse, using a microtome.
   3. Care must be taken to ensure that the cut is accurately made along the 3 planes to avoid difficulties in ultimate examination.
   4. To stain and mount the sections, put them in a petri-dish containing safranin stain for 20minutes.
   5. Wash the sections in running water until the water becomes colorless.
   6. Transfer the sections in 30% alcohol for 15 minutes; 70% alcohol for 10minutes; 85% alcohol for 7 minutes; 95% alcohol for 5 minutes; absolute ethanol for 3 minutes; and xylene for 3 minutes.
   7. Mount the sections immediately on a slide and add a drop of DPX mountant.
   8. Cover the sections carefully using a cover slip in order to avoid air bubbles.
   9. Hold the slide by cloth-pegs to drive off the air bubbles.
   10. For photomicrography, put the permanent slide on a microscope fitted with a camera.
   11. Take photographs using different magnifications i.e. X4 objective and X10 objective
   12. For identification, compare your results with the reference micrographs that has been made earlier and kept in the data base

**8. Reference**

1. A.A. Oteng-Amoako (2006): 100 tropical African timber trees from Ghana.
2. A.J. Panshin and Carl Zeeuw (1970) text book of wood technology
3. E.A. Wheeler , P. Bass and P.E., Gasson (1989): Iawa list of microscopic features for hand identification.

**Standard operating procedure for pH determination in plant samples**

**1: Title:** Standard operating procedure for pH determination in plant samples

**2: Scope:** The method covers analysis of all plant samples.

**3: Purpose:** The purpose of this procedure is to determine the levels of acidity/ basicity in plant samples.

1. **Terms, Acronyms and Definitions:**
2. pH (potential of Hydrogen): is the measure of the hydrogen ion (H+) concentration of a solution on a logarithmic scale. Solutions with high concentrations of hydrogen ions have low pH (acidic pH= 0 to <7) and solutions with low concentrations of H+  ions have high pH (alkaline pH= >7 to 14). pH of 7 is the middle point and it denotes neutral solutions.

**5. Apparatus/equipment**

1. pH meter and electrode
2. Temperature compensation probe
3. 250ml beakers
4. Magnetic Stirrer and bar
5. Stand for probes
6. **Reagents.**
7. Buffer solutions(4,7&10)
8. Distilled water.
9. Samples
10. **Procedure**
    1. Weigh accurately 25g of solid sample and transfer into 250ml beaker.
    2. Add 100 ml of distilled water and place on the magnetic stirrer.
    3. Stir for ten minutes to achieve homogeneity. Now the sample is ready for pH reading
    4. Switch on the pH meter.
    5. Connect all the probes correctly to the meter.
    6. Press the calibration mode on the pH meter.
    7. Place the 50mls of the buffer 4 solution in a beaker.
    8. While stirring gently lower the probes to submerge the bulb of the electrode.
    9. Key in the 4.00 value and press calibrate.
    10. When the meter reading stabilizes, press confirm button.
    11. Remove the probes and thoroughly wash with distilled water and insert in the next buffer.
    12. Key in the next pH buffer and repeat the above for all buffers.
    13. To test for accuracy, place any of the buffers and press measure.
    14. If reading is accurate continue to measure the unknown (samples)
    15. Record readings of the samples.
    16. Report recorded values as pH values of the samples.

**8. References**

1. Kenji G.M &Karanja P.N., (2009): 1st draft edition, analysis of foods practical manual, JKUAT, pp. 33-45.
2. TVA-KIF-SOP-51 (2010) : Standard operation method for determination of pH, Page 1

**Standard operating procedure for strength testing of wood species**

**1. Title:** Standard operating procedure for strength testing of wood species.

**2. Scope:** The method covers testing is carried out to generate data for efficient utilization of all wood species.

**3. Purpose:** The purpose of this procedure is to offer advisory services to timber consumers and designers.

1. **Terms, Acronyms and Definitions:**
2. Vernier calliper: is a precision instrument that can be used to measure internal and external distances extremely accurately.

**5. Apparatus/equipment**

1. Circular saw
2. Thicknesser
3. Universal strength testing machine
4. Vernier caliper
5. Electronic balance
6. Oven

**6. Material**

1. Wood specimens
2. **Procedure**
   1. Apply hydraulic force on the movable cross-head of the machine thereby providing a means for applying tension and compression from the fixed cross-head at the top and to the table at the bottom respectively.
   2. Load measurement is based on the stress subjected to the fixed cross-head. This is achieved through regulation of oil flow to the hydraulic system by closing and opening of valves.

**7.1. Small clear specimen of timber**

1. End-match Specimen of same sectional size from a stick 1-1.5metre long and appropriately label before cutting the final test specimen sizes.
2. In marking of test specimen on the stick, first, quality priority is given to the choice for the bending, and then compression parallel to grain.
3. Store the test specimen in a uniform atmosphere before testing.
4. Measure the dimension of each specimen to an accuracy of not less than ± 0.3 percent or 0.2mm whichever is greater.
5. Take measurements before testing of specimens and when sure they have attained uniform moisture content.
6. Take weights of specimens just before the test commences.
7. Carry out a trial test of the same wood type specimen before the actual testing is started. This will act as control for loading rate and approximate range of load reading device. With the test specimen mounted on the machine and immediately before actual testing starts, the room temperature and humidity is read and recorded.
8. Preserve the test specimen for later inspection of mode of failure.
9. Determine the moisture content for each specimen by using the formula:

Moisture content =Initial weight- oven dry weight/oven dry weight %

**7.2. Strength testing**

Testing is carried out in accordance with BS EN 408 1995 standard.

* 1. **Compression Parallel to grain test**

1. Test specimen measures 20 x 20 x 60mm with end faces truly parallel to each other and right angles to the long axis.
2. Attach the Compression platen to the underside of the moving cross-head of the universal strength testing and the specimen cage to the machine table.
3. Apply the load continuously throughout the test at a rate of cross-head motion of 0.6mm per minute.
4. At the end of test the maximum load is recorded and type of failure sketched.

**7.4. Shear parallel to grain test.**

1. Test specimen is a cube 20mm or 50mm.Matched pairs are required for radial and tangential loading.
2. Attach the compression platen to the underside of the moving cross-head of machine and fit the shear tool on the machine table.
3. Apply the load continuously throughout the test at a rate of cross-head motion of 0.6mm per minute.
4. At end of test record the maximum load and sketch the type of specimen failure.

**7.5. Static Bending-centre point loading**

1. The test specimen measures 20 x 20 x 300mm.
2. Label the specimen twice near each end on a tangential face.
3. Measure dimensions of specimen then drive three small nails perpendicular to one tangential face in a neutral plane, at the centre and 140mm from the centre.
4. Attach the bending knee to the undersize of the moving cross-head and fit trunnion supports on the machine table.
5. For the purpose of manual load-deflection curve tracing, the load is read at predetermined deflection intervals.
6. Two persons are required for this test. One to be reading the deflectometer and the other recording the load reading.
7. With the cross-head lowered sufficiently to just short of touching the specimen, support the deflection yoke on the two end nails and adjust to measure deflection of the centre point of the neutral axis.
8. Apply the load continuously at a rate of 1mm per minute.
9. Record the maximum load and sketch the specimen failure. Soon thereafter cut a piece of 50mm length from near the mid-length, label and Weigh immediately for moisture content determination.

**7.6. Janka Hardness test**

1. The test specimen measures 20×20×100mm or 50×50×150mm along the grain.
2. Fit the janka indentation tool to the underside of the moving cross-head of the universal strength testing machine and place the specimen holder on the machine table.
3. The distant pieces of the same type of timber as the specimen are firmly pressed against the specimen to make a composite block.50×50×150mm specimen requires no holder.
4. Apply the load at a continuous rate of 6.4mm per minute cross-head motion and remove immediately the bell sounds. One indentation is made on the radial and tangential face respectively then another at the end.
5. Record the maximum load for each indentation on the data sheet.
6. **Reporting**
7. The data that is recorded in KN(kilo Newton) is reported in N/mm2 or mpa(mega pascals)

after computation and analysis.

1. Compression parallel to grain: is reported as compressive or crushing strength.
2. Shear parallel to grain is reported as shear strength.
3. Static bending is reported as modulus of elasticity (MOE) and modulus of rupture (MOR).
4. Janka hardness is reported hardness strength.
5. The report can be accompanied by a conclusion and recommendation where necessary.

**References**

BS EN 408 1995 standard manual