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METHODS OF DETERMINING THE MOISTURE CONTENT OF WOOD

By Jamie Hartley and John Marchant

STATE FORESTS
RESEARCH DIVISION

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JAMIE HARTLEY
AND
JOHN MARCHANT

RESEARCH DIVISION
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The Authors:

Jamie Hartley, formerly Research Officer, Forest Products Section, Research Division, State Forests of New South Wales.

John Marchant, Technical Officer, Forest Products Section, Research Division, State Forests of New South Wales.

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State Forests of New South Wales,
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IMPORTANCE OF SEASONED TIMBER

1. INTRODUCTION

Seasoning enhances many properties of wood, and minimises dimensional changes of wood products in service. It is a requirement of the Australian Standard Specifications for a wide range of timber products. The need for seasoned timber has long been recognised by many specifiers and users of wood products, but there is still some confusion about the precise meaning of the term 'seasoning'.

Wood consists of a large number of small cells, which are generally tubular in shape. The cells in a living tree always contain water. It is in the form of 'free' water in the cell cavities, and 'bound' water in the cell walls, which are fully saturated. The cell cavities are usually not completely filled with free water, but contain both water and air. The free water in the living parts of the tree - the sapwood and inner bark - carries the dissolved minerals and foods that are essential to the life of the tree. The heartwood cells also contain free water, but the amount can vary. In some species it can be as much as is in the sapwood, but in other species, e.g. pines, it may be much less.

When a tree is felled and sawn into timber the wood starts to dry. The free water evaporates first. The stage where all the free water has gone, but the cell walls are still fully saturated, is known as the **fibre saturation point**. The cell walls then lose water until the wood has dried to a condition where the amount of bound water is in equilibrium with the moisture in the air around the wood. This **moisture content** is known as the **equilibrium moisture content (EMC)**, and it depends mainly on the relative humidity of the surrounding air and, to a lesser extent, on its temperature. In most applications wood products are not used in constant environments and the amount of bound water varies, following changes in the relative humidity and temperature. The range of EMC depends on the size of the variations in the conditions, and the rate of response of the wood.

One of the most important effects of changes in the amount of bound water is that the wood changes in size. It shrinks as the moisture content falls, and swells as it increases. The effect is greatest perpendicular to the grain, and is greater in the tangential direction (parallel to the growth rings) than in the radial direction (perpendicular to the growth rings). Dimensional changes in the longitudinal direction (parallel to the grain) are smaller, and are usually insignificant in practice. A 'rule-of-thumb' guide for the ratios of the dimensional changes in the three directions is -

Longitudinal : Radial : Tangential = 1 : 50 : 100

The largest effect is the initial shrinkage as the moisture content falls from the fibre saturation point to the EMC range. This can cause gaps to open in floors, panelling or other items where pieces are closely fitted together. It is also an important cause of warp, and the stresses in the wood caused by the shrinkage can cause checking and splitting. Where these would be unacceptable the timber must be dried to its service EMC before it is installed or used.

The dimensional changes caused by variations of moisture content within the EMC range are not as great, and usually can be accommodated. They are the cause of drawers or doors sticking during periods of damp, humid weather, or of some opening between individual floor or lining boards during very dry periods. The effects can be minimised by drying the wood to the mean of its service EMC range before it is fixed in position or used in the manufacturer of wooden articles such as furniture or joinery.

This leads to the definition of the term **seasoning** -

> **"Seasoning is drying timber to a moisture range appropriate to the conditions and purposes for which it is to be used."**

The appropriate moisture content, or EMC, range varies with different locations and exposure conditions. It can vary from as low as 6 to 8% in the far west of New South Wales, to as high as 15 to 18% in sheltered outdoor situations in some districts of the north coast. It is usually lower in indoor than outdoor locations, and lower in air conditioned buildings than in non air conditioned buildings in the same area. Information about probable EMC ranges in particular situations and locations can be obtained from State forestry departments and the CSIRO Division of Forestry and Forest Products.

The specification for seasoned timber should be the appropriate moisture content (EMC) range. Australian Standard Specifications are generally in the form -

> "The moisture content anywhere within any piece shall be not less than 10% nor more than 15%, except that where this moisture content range is unsuitable for a particular location or purpose, the moisture content anywhere within any piece shall be within two percentage units of an agreed value."

Some old specifications use phrases like "the timber shall be well seasoned", or "the timber shall be left in strips for a period of two years". These are too vague. What is "well seasoned" in one particular location may not be appropriate to the intended use of the timber somewhere else. A specification of drying time is not a specification of moisture content, or even a specification that the timber has been dried to the EMC of the location. It is quite possible to keep timber in drying stacks for very long periods without it reaching a moisture content where it could be called seasoned.

The important thing is that the timber moisture content is in the appropriate range. The methods used by the producer to achieve this are of no importance to the user.

2. *DO NOT RELY ON PERSONAL JUDGEMENT*

Reliable methods of determining moisture content are essential, both for the producer and the user, to avoid the problems that can occur when timber is used at an inappropriate moisture content. Some "rough and ready" subjective methods, such as estimating moisture content from smell, weight, or the way the wood machines, have been used in the past by experienced people. When estimates made by these methods have been compared with reliable measurements it has been clearly shown that the former are unreliable. These methods can provide a rough idea, but the inherent errors are far too great for them to be used for proper quality control.

The objective, reliable methods of determining moisture content are summarised in the section "Methods of Determining Moisture Content", and the two methods in general use in the timber industry are discussed in detail in the sections "Oven-drying Method" and "Electric Moisture Meters".

EXPRESSION AND CALCULATION OF MOISTURE CONTENT

The moisture content of wood can be expressed in two ways -

- The mass of water as a percentage of the total mass of wood plus water. This method is used in the chemical processing industries. The moisture content on this basis is always less than 100%, and is sometimes described as moisture content on a wet basis.

- The mass of water as percentage of the oven-dry mass of wood. Moisture contents will be greater than 100% if the mass of water exceeds the oven-dry mass of the wood. This occurs in green wood of many lower density species, e.g. the sapwood of pines. This method is sometimes described as moisture content on a dry basis.

The second method is the standard practice used in the timber industry, and is the method used in this paper. It has the advantage in timber drying that losses of equal amounts of water give numerically equal decreases in moisture content.

Using this method, the moisture content (regardless of how it is measured) is given by -

$$\text{Moisture content (\%)} = \frac{\text{Mass of moisture}}{\text{Oven-dry mass of wood}} \times 100\ (\%)$$

It is calculated by either of two formulas -

Formula 1 -

$$\text{Moisture content (\%)} = \frac{\text{Initial mass - Oven-dry mass}}{\text{Oven-dry mass}} \times 100\ (\%)$$

Formula 2 -

$$\text{Moisture content (\%)} = \left\{ \frac{\text{Initial mass}}{\text{Oven-dry mass}} - 1 \right\} \times 100\ (\%)$$

An example of the use of these formulas is -

Mass of moisture test piece immediately after it is cut from a board (Initial mass):	52.8 g
Mass of moisture test piece when it has reached constant mass in the oven (Oven-dry mass):	46.9 g

Calculation of moisture content -

Formula 1 -

$$\text{Moisture content (\%)} = \frac{\text{Initial mass} - \text{Oven-dry mass}}{\text{Oven-dry mass}} \times 100\ (\%)$$

$$= \frac{52.8 - 46.9}{46.9} \times 100 = 12.6\%$$

Formula 2 -

$$\text{Moisture content (\%)} = \left\{ \frac{\text{Initial mass}}{\text{Oven-dry mass}} - 1 \right\} \times 100\ (\%)$$

$$= \left\{ \frac{52.8}{46.9} - 1 \right\} \times 100 = 12.6\ \%$$

METHODS OF DETERMINING MOISTURE CONTENT

The main methods of determining the moisture content of wood are -

- Drying in an oven at a temperature of 101 to 105°C.
- Use of a moisture meter that measures electric properties of wood that are affected by moisture content.
- Chemical methods, particularly Karl Fischer titration.
- Distilling off the water and measuring its volume.
- Hygrometric methods.

The first two are in common commercial use, and will be discussed in detail. They are the methods specified in Australian Standard 1080, Part 1 **Methods of Test for Timber Moisture Content.**

Oven-drying is the most widely used general reference method. It has the disadvantages of being destructive and relatively slow, and errors can occur if the wood contains volatile material, other than water, that evaporates during drying. The method consists of cutting test pieces, measuring their mass, then oven-drying them until they come to constant mass.

Moisture meters are quick and convenient, and are suitable for use in most commercial situations. They are widely used in the timber industry. However, they are generally not as accurate as oven-drying.

The Karl Fischer titration, using iodine, pyridine and methanol, is probably the most accurate for all situations. However, it is more appropriate to research than commerce, and is rarely used in practice.

Distillation can be used to measure the moisture content of wood that contains appreciable amounts of volatile material that would cause errors in the oven-drying method. It requires relatively complicated apparatus, is slow, and may not be consistently accurate. It is not convenient for normal commercial practice, but is used for moisture content determination as part of determining the retention of some organic preservatives in wood.

Hygrometric methods measure the relative humidity of air that has come to equilibrium with the wood. They are slower and less convenient than moisture meters, and are rarely used in practice.

1. *OVEN-DRYING METHOD*

(a) General

This is the standard method most widely used as a reference method in the timber industry. It is the method prescribed in the Timber Marketing Regulation for determining moisture content for the purposes of the New South Wales Timber Marketing Act, 1977 (as amended). It is also the method normally used for resolving disputes when the results of other methods, such as electric moisture meters, are challenged.

It must be remembered that it involves determining the moisture content of test pieces, usually cut from boards in a parcel of timber, or cut from timber products. The results strictly apply only to the pieces tested. Their relevance to the whole parcel, or all the timber products, depends on the test pieces being carefully selected to be truly representative. For example, in sampling a parcel of timber, test pieces should be taken from a number of boards located throughout the parcel, not just the more accessible boards on the top and sides which may have quite different moisture contents to those in the bulk of the parcel due to their different exposure history.

This method is usually the most accurate readily available (with the possible exception of Karl Fischer titration) and, in ideal conditions, can give results correct to about 0.3 to 0.4 percentage units of moisture content.

Oven-drying will over-estimate the true moisture content if the wood contains significant amounts of volatile material that evaporates with the moisture during oven-drying. This can occur in species containing natural volatile oils or resins, but the effect is not often large enough to be important, and is usually ignored in practice. However, the errors may be significant in wood that has been treated with preservatives such as creosote or LOSP (light organic solvent preservative).

The opposite can occur if the test pieces contain a significant amount of material other than wood that does not evaporate during oven-drying. This may happen with wood that has been impregnated with salts, resins or polymers. The amount the true moisture content is under-estimated depends on the amount of the additional material present. In wood treated with water-borne preservatives or fire retardants the error is unlikely to be more than about two percentage units of moisture content in the normal range of moisture content of seasoned timber. The error may be much larger in wood with high loadings of additional material, such as wood/plastic combinations, or wood treated with bulking or chemical seasoning agents.

The principal disadvantages of oven-drying are that it is destructive, as it involves cutting test pieces from the wood being tested, and the result is usually not known for about 24 hours. It can be accelerated by drying in a microwave oven, but this is not as reliable as the standard method. This is discussed further in the section "Microwave Oven Drying".

(b) Equipment required

(i) Saw

A saw is required for cutting test pieces. A small bandsaw is most suitable, particularly if many test pieces or moisture distribution test pieces (discussed in the section "Moisture Content Distribution"), are to be cut. A hand saw can be used for cutting mean moisture content test pieces (discussed in the section "Method for Determining Mean Moisture Content"), but is unlikely to be satisfactory for resawing more than the occasional moisture distribution test piece. Saws must be sharp to minimize the amount of heat generated during cutting, which may cause some drying of the test pieces. Circular saws are less suitable because they may cause too much heating of the wood.

(ii) Balance

A balance is necessary for measuring the mass of the test pieces before and after oven-drying. A top-loading type is usually the most convenient. A relatively inexpensive mechanical balance, such as a single or multiple beam, or "Harvard trip" type, is satisfactory. However, if many pieces are to be tested, the purchase of an automatic balance may be justified. In either case, the balance must be capable of measuring the mass of a test piece to an accuracy of ±0.1 g or better. Its capacity should be at least 100 g, and must be as large as the mass of the heaviest piece to be tested. The balance should be located in a position that is sheltered from draughts, and is near the test piece preparation area and the drying oven.

(iii) Drying oven

A well ventilated oven with the temperature controlled at between 101 and 105°C is used for drying the test pieces. The oven trays should be open grids to allow free air circulation around the test pieces. Suitable thermostatically controlled, forced ventilation, electrically heated drying ovens are available from laboratory equipment supply companies.

Alternatives that have been used in the timber industry are ovens constructed on the side of a boiler, or steam heated ovens. The former use radiant heat from an exposed portion of the boiler shell, with the natural upward air circulation regulated by baffled openings at the top and bottom of the oven. The latter use a steam heated radiator in the bottom of the oven, with the air circulation regulated similarly.

(c) Method for determining mean moisture content

Test pieces for determining the mean moisture content of timber boards or products are full cross sections, between 15 and 20 mm long in the direction of the grain. They should be cut at least 0.5 m from the ends of the boards or products to avoid errors caused by faster drying at the ends. It is often less wasteful to cut a test piece from the centre of a long board, leaving two usable short lengths, than to discard the end 0.5 m. In timber boards, or products such as tool handles, that are less than 1 m long, the test piece should be cut from the centre of the length. Small timber items, such as mosaic parquetry fingers, can be tested whole. Test pieces should be typical of the general timber in the boards or products, and should be free of defects such as knots, gum veins, etc.

If it is not possible to weigh the test pieces immediately after they have been cut, test specimens, at least 300 mm long in the direction of the grain, should be cut from the boards or products at least 0.5 m from their ends. Short pieces of timber, or products less than 1 m long, can either be taken whole as test specimens, or specimens can be cut from the centre of their length. The test specimens should be wrapped immediately in polyethylene sheeting, aluminium foil, or similar, to minimise changes in their moisture content, and stored in a cool, dry place until testing. A test piece should be cut from the centre of the length of each test specimen. The delay between taking the test specimens and cutting the test pieces should be kept to a minimum and, if possible, should not exceed 24 hours.

Any loose sawdust, splinters, etc. must be removed from each test piece by brushing, scraping, or rubbing with sandpaper, and the test piece should be weighed immediately to determine its initial mass. Speed is important, as the moisture content of a test piece can change rapidly once it has been cut, causing an error in the result of the test. The time the test piece is exposed between cutting and weighing must be kept as short as possible. It is good practice to wrap each test piece in a polyethylene bag between each step to reduce the risk of moisture content changes.

If the mass of a test piece is less than about 50 g, two or more adjacent test pieces should be cut and weighed together, so that the initial mass is determined with a precision of at least one in 500, i.e. 50 g to an accuracy of ±0.1 g. With a balance accuracy of ±0.01 g, the necessary precision can be achieved with test pieces as light as 5 g.

The test pieces are placed in the oven, separated on the oven trays to ensure a free air circulation around each piece. Oven-drying continues until the test pieces reach a constant mass, when they are removed and re-weighed to determine their oven-dry mass. Fresh test pieces should not be added to an oven that contains pieces that are nearly oven-dry, as some of the moisture evaporated from them may be absorbed by the pieces in the oven.

Oven-dry wood will rapidly absorb moisture from the atmosphere, so care must be taken to ensure this does not happen between the removal of the test pieces from the oven and re-weighing. The test pieces can be weighed hot, immediately after removal from the oven, but this may reduce weighing accuracy, due to the air currents around the balance caused by heat from the hot test piece. This is unlikely to be a problem with balances only accurate to ±0.1 g, but can occur if the accuracy is ±0.01 g or better. It can be avoided by cooling the test pieces before re-weighing, either in a dessicator, wrapped in polyethylene or similar, to prevent moisture uptake.

Oven-drying usually takes about 18 to 24 hours. The test pieces are assumed to have reached a constant mass when it does not change by more than 0.1 g (for test pieces with an initial mass of about 50 g or more) between successive weighings, separated by an additional period of oven-drying of at least two hours. This is equivalent to specifying that constant mass has been reached when it does not change by more than 0.2% between successive weighings. This will give a value of the moisture content that is sufficiently accurate for normal commercial purposes. However, a Note in AS 1080, Part 1 recommends the higher precision of a change in mass of not more than 0.1% between successive weighings. This can be adopted if the balance used is sufficiently accurate, and greater precision is required.

Once the initial mass and oven-dry mass of each test piece have been determined, its moisture content can be calculated using either of the formulas given in the section "Expression and Calculation of Moisture Content". The result is often expressed to the nearest 0.1 percentage unit of moisture content, but it should be remembered that this is more precise than the inherent accuracy of the method.

(d) Moisture content distribution

Test pieces for determining the distribution of moisture content through the thickness of a piece of timber are full cross sections, about 30 to 35 mm long in the direction of the grain. They should be cut following the procedure outlined in the section "Methods of determining moisture content" above for test pieces for determining the mean moisture content. It is normal practice to also cut an adjacent test piece for determining the mean moisture content.

The moisture distribution test piece should be marked on its cross-cut surface and resawn into two **case** sections, one **core** section and, if required, two **intermediate** sections as shown in Figures 1 to 4 (page 9). The particular pattern used depends on the type of saw available, and the information required from the test. The patterns in Figures 1 and 3 are easier to cut with a handsaw than those in Figures 2 and 4, but any of the patterns can easily be cut with a small bandsaw. Intermediate sections are usually only cut from material more than 30 mm thick.

The moisture content of the distribution sections is determined exactly as described in the section "Method for Determining Mean Moisture Content" for mean moisture content test pieces.

In most cases the information required is only the general gradient from the case, through the intermediate (if required), to the core. This assumes that the moisture contents of both sides of the piece of timber are roughly the same, which is usually true in normal timber drying practice. In this case any of the cutting patterns may be used, and the two case sections are weighed together to provide a mean case moisture content. The two intermediate sections are treated similarly.

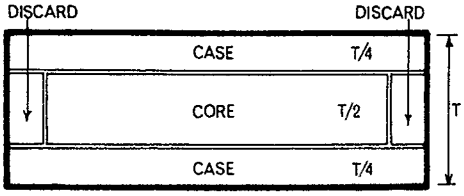

Fig 1

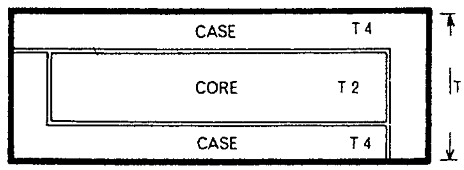

Fig. 2

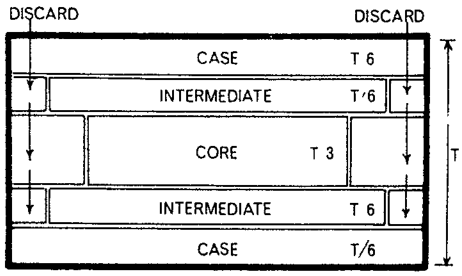

Fig. 3

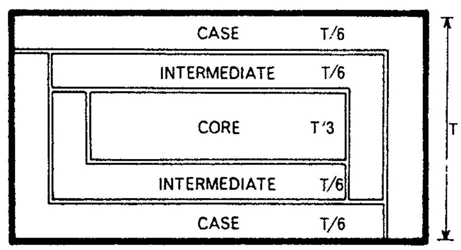

Fig. 4

Figures 1, 2, 3 and 4. Cutting patterns for moisture content distribution.

Situations can arise where there is a suspicion that the moisture content of one face of a piece of timber may be substantially different to that of the other face. This could occur through rain wetting, or different exposure conditions on the two faces. It can be detected by using the cutting patterns in Figures 1 or 3, and determining the moisture content of each section separately.

In very thick material it is sometimes of interest to have more than one intermediate section between the case and core. These are cut following the principles shown in Figures 3 and 4.

(e) Microwave oven-drying

(i) General

Conventional oven-drying usually takes at least 18 to 24 hours. This is one of its disadvantages, particularly if an approximate result is required quickly. The oven-drying stage can be carried out much faster by drying the test pieces in a microwave oven. However, considerable care must be exercised as it is very easy to go straight through the oven-dry stage and char, or even set fire to the test pieces.

A small domestic microwave oven is suitable. It must be well ventilated, and forced ventilation is preferable. The most common problem is excessive heating of the test pieces, so the oven should have provision for power below full output - either a 'defrost' setting, or switched proportions of full output. A turntable helps to eliminate localised heating at 'hot spots' in the oven. Placing the test pieces on paper towels helps moisture escape from their bottom surfaces.

Microwave energy is absorbed preferentially by the water molecules in the test pieces, producing heat. At the start of drying the moisture is usually distributed fairly uniformly through the test pieces. However, the water evaporates from the surface of the test pieces (particularly the end grain) and, as drying progresses, more heat is generated in the interior where the moisture content is higher. As dry wood is an excellent insulator against heat conduction, the interior may heat more rapidly than the heat can be conducted away. This can lead to overheating of the interior of the test pieces before they are uniformly oven-dried - causing charring or, in extreme cases, setting them on fire. It is also possible, if a lot of moisture is present, that the water in the interior of the test pieces may evaporate (boil) faster than it can get away to the surface. This can lead to a build-up of interior steam pressure which may result in the test pieces exploding.

The aim of microwave oven-drying is to apply the energy at a rate that will evaporate all the moisture from the test pieces, bringing them to constant oven-dry mass, without over-heating. The most suitable technique for any application must be found by 'trial and error'. The main variables to be determined are the oven output power level, and the length of the successive periods of heating and cooling. A technique suggested for use as a starting point in developing an optimum method for a particular application is -

1. Weigh the test pieces to determine their initial mass.

2. Subject them to an initial period of heating in the microwave oven.

3. Remove and weigh the test pieces.

4. Cool the test pieces for a fixed period, either in a dessicator, or unwrapped in the air.

5. Re-weigh the test pieces.

6. Subject them to an additional heating period in the oven.

Repeat steps 3. to 6. until the test pieces come to constant mass. It is often difficult to determine this precisely, but a stage is usually reached where the rate of loss of mass decreases with the mass becoming approximately constant, before the rate increases again, during subsequent heating periods, as the test pieces start to char. Another indication of reaching constant mass is when the mass measured in step 5. is not less than the mass determined in step 3. The constant mass is taken to be the oven-dry mass and the moisture content is calculated from this, and the initial mass, using either of the formulas given on pages 3 and 4.

A suggested starting point for developing an appropriate technique is an initial heating period of about five minutes (may be longer for material with high moisture content), followed by subsequent heating and cooling periods of about three minutes each, using an oven power of about 30 to 40% of its full output, or the 'defrost' setting (for a typical domestic microwave oven with a full power output of about 600 W). Higher power may be suitable if a number of test pieces are to be dried at the same time.

If the test pieces do not come to constant mass, but continue to loose weight until they start to char, the energy input is too high. The technique should be modified by reducing the oven power or shortening the heating periods and/or lengthening the cooling periods. The opposite approach should be taken if oven-drying is excessively long.

This method is capable of measuring moisture content to within about one percentage unit of moisture content of the results obtained by conventional oven-drying (as described in (a) to (d) under "Oven-drying Methods"), in a total time that may be as short as 20 minutes, and will usually be no longer than 45 minutes. However, it is not as reliable as, and the results should be confirmed by, conventionally oven-drying adjacent tests pieces.

The risk of over-heating can be reduced, and drying accelerated, by cutting test pieces that are thinner in the direction of the grain than those used for conventional oven-drying. However, this increases the risk of errors caused by moisture content changes between the cutting and initial weighing of the test pieces.

(ii) Precautions

As with any microwave oven, it is important that it be kept clean with no accumulation of debris, wood residues, etc. The air vents on the oven must allow free ventilation, and should not be blocked or obstructed in any way. Microwave leakage can be dangerous, so it is important that the oven is maintained in a good state of repair. The oven door must be properly closed when the oven is in use, and there must be no damage or obstruction to the door, the door hinges and latches, or the door seals and sealing surfaces. Microwave ovens use high electric voltages so the protective casing should only be removed by skilled service personnel.

The magnetron in a microwave oven may be damaged if the oven is operated when it is empty, or when it does not contain a sufficient quantity of energy absorbing material. Towards the end of oven-drying wood test pieces the energy absorption can be quite low - particularly if there is only one piece in the oven. For this reason it is good practice to have an additional energy absorber in the oven. A simple way is to put about 500 mL of water in an open non-metallic container in the oven.

Anyone who uses a cardiac pacemaker should check the effect of electronic equipment on its operation before using a microwave oven.

2. *ELECTRIC MOISTURE METERS*

(a) General

The oven-drying method is the most direct and accurate method of determining moisture content in most cases, as it involves a direct measurement of the mass of wood material and the mass of the water evaporated from it. It has the disadvantages of being destructive, and of having a considerable delay before the result is known. There is a need for a quick, reliable, non-destructive method for assessing moisture content that can be used in normal timberyard and commercial practice. This need is satisfied by portable electric moisture meters which measure moisture content indirectly from electric properties of wood that change as the moisture content changes. There are two types -

- Resistance meters, which measure the electric resistance of the wood.
- Meters that measure the dielectric properties of wood - the dielectric constant, dielectric loss factor, or a combination of both. These are often referred to as 'capacitance meters', even though this term strictly applies to meters that only measure the dielectric constant. They may also be referred to as 'radio frequency meters'.

Both types have advantages and limitations, but resistance meters are probably the most suitable for most applications, and are the type most often used in practice.

Information about the makes of meter that are available in Australia, and the firms or agents that can supply them, can be obtained from State Forestry Departments or the CSIRO Division of Forestry.

Fixed meter installations for the production line monitoring of moisture content are also available. They can measure either the resistance or dielectric properties of the wood. Both types use non-penetrating electrodes. Systems are also available for monitoring the moisture content of timber during kiln drying

- either from resistance measurements from electrodes embedded in the wood, or from the alternating current impedance between electrode plates in the kiln charge, or between an electrode plate in the charge and the ground. A detailed discussion of these installations and systems is beyond the scope of this paper, which will concentrate on portable moisture meters of the type most suitable for normal timberyard and timber industry use.

(b) Resistance meters

(i) Principle of operation

Dry wood is an excellent electric insulator, but its electric resistance falls as its moisture content increases. This effect is most pronounced for moisture contents below the fibre saturation point (about 25 to 30% for most species). In this range there is an approximately linear relationship between the logarithm of the moisture content and the logarithm of the resistance. The effect is large - the resistance at a moisture content of 8% is roughly 1000 times greater than at 19% - and it provides a method of estimating the moisture content of wood from a measurement of its resistance. Above the fibre saturation point the relationship is poorer, with more variation, and resistance measurements cannot provide reliable estimates of moisture content. At moisture contents lower than about 6% the resistance is too large to measure in practice.

The relationship between electric resistance and moisture content provides the basis for resistance meters. The resistance is measured by applying a voltage between two poles of an electric circuit that are in contact with the wood, and measuring the current that flows between them. The actual contact with the wood at each pole is made by blades, pines, needles or nails driven into the wood. The poles of the circuit are usually between 20 and 40 mm apart, but the spacing is not critical as the resistance is primarily the surface resistance between the contacts and the wood, and is almost independent of the length of the path the current takes through the wood.

The effective resistance at a pole of the circuit is the lowest resistance between the wood and the contact. This occurs where the moisture content of the wood touching the contact is highest. However, the lowest resistance in the electric circuit is the lowest between the wood and the contacts at **both** poles of the circuit, so the moisture content measured by the meter is the highest that occurs at the contacts at **both** poles.

Surface contacts on a piece of wood can only provide a measure of the moisture content of the layer of wood cells right at the surface. In most cases this will not be the same as the moisture content of the wood within the piece, so this type of contact is generally unsuitable for measuring the moisture content of solid wood sections. The electric contact must be made with the portion of the wood within the cross section that is to be measured.

The resistance is usually displayed on the meter in percentage units of wood moisture content, rather than resistance, using values the manufacturer has assumed for the relationship between resistance and moisture content. This can vary with a number of factors - particularly species, temperature, and whether the direction of current flow is parallel or perpendicular to the grain. The information needed for the proper use of a meter should be provided by the manufacturer.

(ii) Effect of species

The relationship between electric resistance and moisture content is not the same for all wood species. Differences occur, mainly due to differences in the amounts and chemical composition of extractives in the wood. The relationship most commonly used for moisture meters is that for North American coast type Douglas fir (oregon). Values for resistance at different moisture contents have been determined in Australia and the USA and are those most commonly used for the calibration of resistance meters.

The Australian data are for resistance with the current flow perpendicular to the direction of the grain, at a temperature of 20 to 21°C. Correction figures for various species tested in this way, using meters based on this calibration data, are given in Appendix 1. These corrections strictly apply only for the conditions stated, but they may be used as a general guide for the effect of species on the readings of resistance meters.

The meter manufacturer should supply information about the species that the meter is calibrated for, and all necessary information to enable appropriate corrections to be made when the meter is used on other species required by the customer. Some meters have a number of different scales, or different plug-in modules, for different groups of species.

(iii) Effect of temperature

The electric resistance of wood decreases with increasing temperature, so resistance meters will tend to read high if the wood temperature is higher than the temperature assumed for the calibration of the meter. This can happen if meters are used on hot timber that has just been removed from a drying kiln, or on timber in normal timberyard practice during hot weather - particularly if it is out in the sun. The converse also happens - meters read low on timber that is below the calibration temperature.

Most meters are calibrated for temperatures of about 20 to 21°C. Errors caused by the effect of temperature are generally only minor if the wood temperature is within about 5°C of this (i.e. between about 15 and 25°C for most meters) and are usually ignored in practice. If the wood temperature is more than about 5°C away from the calibration temperature the meter reading should be corrected for temperature. Values of the corrections to be made are given in Appendix 2, which is based on a calibration temperature of 20 to 21°C. The correction of the meter reading for temperature should be made first. The corrected reading obtained should then be corrected for the effect of species, as described in the section "Effect of Species".

Meter manufacturers should supply details of the calibration temperature they have used, and details of temperature corrections that should be made. Some meters have a built-in facility for automatically correcting for the wood temperature entered by the user on a dial on the meter. Some automatic systems for monitoring wood moisture content during kiln drying incorporate sensors to measure the wood temperature and automatically correct for it.

(iv) Effect of grain direction

The electric resistance of wood is about half as large for a current flowing parallel to the grain as it is for a current flowing perpendicular to the grain. This means that the reading of a resistance meter will be one to two percentage units of moisture content higher for parallel current flow than for perpendicular. The Australian calibration data are for current flow perpendicular to the grain, and the contact made with the wood must be such that the poles of the electric circuit are separated across the grain. Some other meters, particularly those made in the USA, measure resistance along the grain, and the contact with the wood must be made this way. The meter manufacturer should clearly state which way the meter is to be used.

(v) Meters and electrodes

Some electric resistance meters and their electrodes are shown in Plates 1 to 5. The electrodes contain the two poles of the electric circuit that contact the wood. The actual contact is made by pins, needles or blades, connected to the electrode poles, and driven into the wood. The body of the electrode, the insulation of the flexible lead connecting it to the meter, and the plug and socket at the meter must have a very high electric resistance, so that the resistance measured is that of the wood, not leakage in the circuit.

A number of different arrangements of the contacts in the electrode poles are in common use.

One standard type of electrode uses two tempered steel needles (steel gramophone needles, or similar) in each pole. The needles are about 10 to 15 mm apart and project about 6 to 8 mm from the pole piece. This type of electrode is suitable for testing timber up to about 32 mm thick. The body of the electrode can be hammered to get full penetration of the needles into the wood, and the base is recessed to accept a lever for extracting the electrode. Variations of this pattern are offered by a number of manufacturers.

For deeper penetration in thick timber, larger diameter, more robust pins are necessary. In this electrode type there is usually only one contact pin at each electrode pole, to make it easier to penetrate the wood. The electrode often has a sliding weight on a shaft for hammering the pins into the wood and extracting them after the readings have been made. Electrodes of this type are known as 'sliding hammer' electrodes. They usually contain a gauge to indicate the depth of penetration of the contacts into the wood.

Barlow Assoc. Aust. Pty Ltd

Plate 1. Electric resistance moisture meter with a 'sliding hammer' electrode. Made in Australia.

Pins of various length are available. They may be of bare metal, which contact the wood for their full penetration depth. An alternative is pins with bare tips and insulated shanks that only make electric contact with the wood at their tips. These are useful for investigating the variation in moisture content at different distances below the surface of thick timber.

Two-pin electrodes, with one pin at each pole, generally give lower meter readings than four-pin electrodes with two pins, or needles, at each pole. This happens even though they have a larger contact area with the wood, due to their larger diameter. As most of the meter calibration data has been determined using four-pin electrodes, this effect should be allowed for by adding about 0.5 to meter readings below 15%, and 1 to readings above 15%, when using two-pin electrodes.

(SC13712)

Plate 2. Electric resistance moisture meter with a 'sliding hammer' electrode. Made in the USA.

Another electrode type suitable for robust timberyard use has a blade contact at each pole. The electrode has a handle that allows the blades to be driven into the timber with a single swinging hammer-like blow. It is suitable for testing timber up to about 32 mm thick. The blades can only be driven into the wood parallel to the grain, so this type of electrode can only be used for obtaining readings of resistance perpendicular to the grain. Electrodes with pin or needle contacts can be used for measurements of resistance either parallel or perpendicular to the grain.

(SC137198)

Plate 3. Electric resistance moisture meter with a 'sliding hammer' electrode. Made in the UK.

An advantage of resistance meters with removable electrodes is that the type of electrode most suitable for any particular application can be connected to the meter. The electrode is external to the electric circuitry of the meter. This is not the case with dielectric meters, in which the electrode is an integral part of the meter.

Some 'budget' priced meters are available that have their electrode contacts in the form of two pins attached to the meter housing, rather than a separate electrode connected to the meter by a flexible lead. These have only limited application, as it is generally not possible to obtain much penetration of the contacts, particularly into harder timber without damaging the meter.

Plate 4. Needle electrode with separate hammer for driving and extraction.

Plate 5. Blade (hammer) electrode for electric resistance moisture meters.

Different makes of meter cover different ranges of moisture content. An intending purchaser should ensure that the meter covers the range he requires. It should be remembered that it is usually impossible to get meter readings below about 6%. For a species like radiata pine which gives low meter readings, this corresponds to a true moisture content of about 8 to 9%. Meter readings above about 25% are not usually required in timberyard practice, and are subject to large errors. Some meters will give readings up to 80%, or above, but this extended range is usually of little practical use.

(vi) Measuring mean moisture content

In normal timberyard practice, drying timber has a moisture gradient - being highest at the centre and lowest at the surface. The mean moisture content of a piece will approximate the moisture content at a depth below the surface of about one quarter to one fifth of the thickness. This can be measured by a resistance meter, using electrode contacts driven into the timber to this depth. The common four-pin or blade electrodes are suitable for this purpose in timber up to about 32 mm thick. Two-pin electrodes can also be used, but should only be driven in to the required depth.

Readings should be taken in areas where the wood is representative of the whole piece, and is free of defects such as checks, decay, holes, gum or resin veins, knots, etc. They should not be made near the ends of pieces, to avoid the possible effects of faster end-grain drying.

The meter will record the highest moisture content of the wood in contact with both poles of the electrode. In periods of high humidity, or in timber that has been rain wetted, the surface moisture content may be higher than the mean. If the electrode contacts are made with this surface layer the readings obtained will be higher than the mean, and timber that may be satisfactorily dried could be rejected. This can be avoided by using insulated contacts driven to the required depth.

Timber with free water on the surface should not be tested with resistance meters, even using insulated electrode pins. There is a risk that the water will be drawn into the wood as the pins are driven in, leading to false high readings. Such timber should be allowed to surface dry before it is tested.

Readings may be taken on the freshly cut end-grain of timber. The electrode contacts should be orientated so the direction of current flow is parallel to the wide face of the piece. A correction of one to two percentage units of moisture content should be added to the readings of meters calibrated for measuring with the current flow parallel to the grain.

The estimate of the mean moisture content of a piece will be improved if a number of readings are taken at different positions. This will also provide an indication of the variation in mean moisture content along the length of the piece. If the moisture content of a parcel of timber is to be assessed, tests should be made on a number of pieces selected to be truly representative of the whole parcel.

In timber more than about 32 mm thick it will usually be better to assess the moisture content distribution than to take single readings of mean moisture content at one fifth to one quarter of the thickness. This is discussed in the next section "Measuring Moisture Control Distribution". Readings from a number of locations will provide an estimate of the variation in moisture content through the cross-section and along the length, as well as the mean moisture content.

Occasionally the reading of a meter will drift with time usually downwards. If this occurs, the reading immediately after driving the electrode contacts into the timber should be taken.

(vii) Measuring moisture content distribution

It is often desirable to assess the distribution of moisture content within the cross-section of a piece of timber, as well as its mean moisture content. This is more likely to be important with thick material than with boards 32 mm, or less, in thickness. It may also be important if large variations in moisture content are present due to uneven drying, or from the exposure conditions of the timber.

In most cases, particularly while timber is drying, the moisture content is higher in the centre than at the surface. This can easily be detected, and the gradient in moisture content measured, by taking successive readings as the electrode contacts are progressively driven from the surface to the centre. Long two-pin sliding hammer electrodes are particularly suitable for this purpose.

Drying timber usually has a continuous gradient in moisture content from the centre to the surface. Sometimes there is a break in the gradient, and the moisture distribution is in the form of a 'wet core' surrounded by a shell of much drier wood. This will cause a marked increase in the meter reading as the electrode contacts penetrate the wet core.

If an electrode with contacts that will reach the centre is not available, readings can be obtained from two nails progressively driven into the timber. They should be spaced at approximately the same distance apart as the pole of the meter electrode and located so the current flow between them is in the direction relative to the grain appropriate to the meter being used. The pole or contacts of the meter electrode are pressed on the heads of the nails to complete the circuit. When nails are used, the same correction to the meter readings should be made as for two-pin electrodes, as discussed in the section "Meters and Electrodes".

Cases may occur where the gradient is reversed, i.e. the moisture content is higher near the surface than at the centre. This cannot be measured by driving nails or uninsulated electrode contacts into the wood, as the meter will respond to the highest moisture content encountered, which is that near the surface. Two-pin electrodes with pins with bare tips and insulated shanks can be used. They will give readings of the moisture content at the depth the tips are driven into the timber. An alternative is to drill two holes into the timber to the depth required, and drive nails about 5 mm into the bottom of the holes to form the contact. The holes must be larger in diameter than the nails, and care must be taken to ensure that the nails do not make electric contact with the sides of the holes. The spacing and orientation of the holes, and the method of taking readings is the same as for the use of nails discussed in the previous paragraph.

Free water on the surface of the timber may cause large errors, as discussed in the section "Measuring Mean Moisture Content".

If the timber can be cross-cut, moisture gradients can be determined using the electrode contacts at different position on the freshly cut end-grain, following the procedures outlined in the section "Measuring Mean Moisture Content".

(viii) Effect of preservatives

Wood that has been treated with water-borne preservatives or fire retardants will generally have a lower resistance than untreated wood. This increases the readings of resistance meters. The error depends on the amount of chemical present, and increases with increasing moisture content. At true moisture contents below about 15%, meter readings may be one to three percentage units of moisture content high. At higher moisture contents the errors are larger, and may be too variable for corrections to be made to meter readings. In general it can be said that the true moisture content of timber treated with water-borne salts is likely to be lower than that indicated by resistance meters.

Oil - or solvent-borne preservatives, such as creosote or LOSP, may have the opposite effect - increasing resistance and lowering meter readings. The effect is unlikely to be as great as the effect of water-borne salts. Data available for radiata pine treated with copper naphthenate LOSP indicate meter readings may be low by about one percentage unit of moisture content.

(ix) *Effect of coatings and glue lines*

Most surface coatings on wood have little or no effect on meter readings. If there is a suspicion that a surface coating may be electrically conductive it should be just pricked with the electrode contacts. A high meter reading will indicate that it is conductive and will affect readings. In this case the electrode contact with the wood must be insulated from the coating.

Some types of glues used in plywood are electric conductors and will affect the readings of resistance meters. The effect can be determined by observing whether the meter reading increases sharply as the first glue line is penetrated by the electrode contacts. If this happens, meter readings on the plywood will be unreliable, and the moisture content should be determined by oven-drying.

(x) *Accuracy and precision of results*

The accuracy of electric resistance meters is not limited by their ability to measure the resistance between the electrode contacts, within their range. It is limited by the accuracy of the calibration relationship between resistance and moisture content that has been assumed by the manufacturer, the effects of the various factors discussed previously, and the natural variability of the properties of wood.

The calibration relationship is not usually supplied by the manufacturer, so it must be taken on trust unless the user is prepared to make an extensive investigation comparing meter readings with the values of moisture content obtained by oven-drying. This is not usually practicable. Comparisons between the readings of meters connected to the same fixed resistances indicate that there are some differences between the calibration relationships used by different manufacturers. These usually do not amount to more than one percentage unit of moisture content in the range below about 25%.

The effects of species, temperature and grain direction should be allowed for, as discussed previously. If this is done, the moisture content indicated by an individual meter reading on untreated timber made near the calibration temperature is probably accurate to within two percentage units of moisture content in most cases, and may be within one percentage unit. The accuracy of the assessment of the moisture content of a piece of timber can be improved by taking additional readings at different locations.

When assessing the moisture content of a parcel of timber, measurements should be allowed for, as discussed previously. If this is done, the moisture content indicated by an individual meter reading on untreated timber made near the calibration temperature is probably accurate to within two percentage units of moisture content in most cases, and may be within one percentage unit. The accuracy of the assessment of the moisture content of a piece of timber can be improved by taking additional readings at different locations.

When assessing the moisture content of a parcel of timber, measurements should be made on a sufficient number of representative pieces to allow an estimate to be made of both the mean moisture content of the parcel, and its variation within and between individual pieces. The number of tests required depends on both the precision required in the estimate, and the size of the variations. A detailed discussion of sampling requirements is beyond the scope of this paper. Reference should be made to a standard text on statistical sampling procedures for further information.

Estimates of moisture content from resistance meters should not be recorded to an accuracy greater than the nearest half percentage unit of moisture content. The nearest one percentage unit is probably more realistic, and is adequate for most practical purposes.

(xi). Limitations of resistance meters

Electric resistance meters provide a convenient, non-destructive method for measuring the moisture content of wood in many practical situations. They can be used for measuring both the mean moisture content of a piece of wood, and its variation within the piece. Various aspects have been discussed in the preceding sections. A summary of some aspects and limitations of resistance meters is -

- Readings are only reliable between about 6 and 25%.
- Resistance meters cannot read very low moisture contents.
- Readings must be corrected for the effect of the species being tested.
- Readings must be corrected if the temperature of the wood is appreciably different from the calibration temperature used by the meter manufacturer (usually about 20°C).
- Readings should be made with the current flow in the wood in the same direction, relative to the grain, as has been assumed by the meter manufacturer.
- Electric contact is made below the surface of the wood. This involves some damage, which may be unacceptable in surfaces that are exposed to view.
- The reading is of the highest moisture content encountered by the electrode contacts. Insulated contacts should be used, or similar precautions taken, to avoid errors when testing wood with a relatively high surface moisture content.
- Free water on the surface of the wood is likely to cause large errors in readings.
- Meters are likely to read high when testing wood containing water-borne salts.
- The presence of oil- or solvent-borne preservatives may cause meters to read low.
- Conductive surface coatings can cause errors unless the electrode contacts are insulated from them.
- Glue lines may cause errors if they are penetrated by the electrode contacts.
- The method measures moisture content indirectly - from its effect on the electric resistance of the wood. It is inherently less accurate than a method like oven-drying that directly measures the amount of moisture present in the wood.

(xii) Precautions in the use of resistance meters

- Keep the meter and electrode(s) clean and dry, and in good condition. Store in a clean, dry, interior location. Avoid extreme temperatures. Handle the meter and electrode(s) carefully. Do not subject the meter to mechanical shock. Particular care should be taken of the installation of the lead connecting the electrode to the meter.
- Keep the electrode contacts in good repair. Straighten the needles, pins, or blades whenever they start to bend. Use a small pair of pliers if necessary. Replace broken electrode contacts.
- Check that the power supply is adequate before using the meter. Most battery powered meters have provision for testing the condition of the battery. Replace the battery (or batteries) as soon as it becomes necessary. Switch the meter off when it is not being used (done automatically in some meters).

- Regularly check the insulation of the meter/electrode system. With the electrode connected to the meter, and the electrode poles and contacts not in touch with anything (except the body of the electrode) the meter reading should be less than the minimum scale value. If it is not, the electrode assembly and the plug/socket connection to the meter should be inspected and cleaned, if necessary, with alcohol or methylated spirits, and dried thoroughly. The electrode and its lead should be inspected for any damage, or any other cause (such as the presence of moisture) that might reduce the effectiveness of the insulation, and appropriate action taken.

- Regularly check the circuit continuity of the meter/electrode system, by bridging between the electrode contacts with a hand. The meter should show an apparently high moisture content.

- Follow the manufacturer's instructions supplied with the meter. Insert the electrode contacts in the wood so that the current flow is in the direction, relative to the grain, contained in the instructions.

- Apply any necessary correction for electrode type in accordance with the manufacturer's instructions.

- Apply the appropriate corrections for wood temperature and species contained in the manufacturer's instructions. They should be applied in the order contained in the instructions. For most meters, the reading should be corrected for wood temperature before applying the species correction.

- Condensation may occur on a cool meter and/or electrode that is taken into hotter surroundings for use, e.g. taken from an air-conditioned office out into a hot timberyard in summer. The condensation may reduce the insulation of the system. Sufficient time should be allowed before using the meter and/or electrode for them to warm to the new ambient temperature, and for any condensation to evaporate.

- Try to avoid using meters during damp or very humid weather. If it is absolutely necessary, store the meter in a warm, dry place and keep its exposure to the humid conditions to minimum. Take care to keep the meter and electrode dry, and check the insulation regularly.

- Avoid excessive handling of the electrode assembly in the region of the poles of the circuit and the contacts with the wood. Dirt or perspiration on the assembly may reduce the effectiveness of the insulation.

- Meters should not be taken into, or used in, hot timber drying kilns.

- Only take readings on clear, sound wood that is free of obvious defects such as knots, decay, pith, holes, included bark, resin or gum veins, etc. The path of the current should not cross any obvious splits or checks.

- Care should be taken on thick material. Refer to the sections "Measuring Mean Moisture Content" and "Measuring Moisture Content Distribution". Care must also be exercised when taking readings on thin materials, like veneer, to ensure the electrode makes good electric contact with the wood.

- If the calibration relationship of the meter is known, the meter readings can be checked against resistors connected across the poles of the electrode. Some values for resistance at selected moisture contents are given below. These are values determined in Australia for meter readings on North American coast type Douglas fir at 20 to 21°C, with the current flow perpendicular to the grain. They do not apply to meters based on different calibration relationships.

Meter reading (% moisture content)	Electric resistance (megohm)
8	5000
12	180
16	19
20	3.4
24	0.77

(c) Dielectric meters

(i) Principle of operation

Wood has the properties of an electric insulator, or dielectric, as well as the resistance to direct current that is used in resistance meters. Dielectric meters measure one or both of the dielectric properties that are affected by moisture content. These are the dielectric constant and the power factor (or loss factor) when the wood is penetrated by an alternating electric field. These meters are often known as 'capacitance meters' or 'radio frequency meters', even though these terms are not strictly accurate for dielectric meters in general.

The dielectric constant of wood is the ratio of the capacitance of a capacitor containing the wood sample between its plates to the capacitance of the same capacitor containing empty space. It is basically a measure of the relative amount of energy that can be stored in a capacitor containing the wood. The dielectric constant increases with increasing wood moisture content. This effect becomes greater as the frequency of the electric field decreases. The dielectric constant also increases with increasing wood density and with increasing wood temperature except at very high moisture content where the effect becomes erratic. Meters that measure the capacitance (or dielectric constant) of the wood are accurately described as **capacitance meters.**

In a capacitance meter the wood sample penetrated by the field between the electrode plates forms a capacitor that is part of an oscillator circuit. The frequency of the circuit varies with changes in the capacitance of this capacitor, i.e. with changes in the dielectric constant of the wood. The meter detects this frequency change and displays it as a reading. If a relationship is assumed between the frequency change and the moisture content of the wood, the display can be in units of % wood moisture content.

The energy stored in a perfect dielectric in an electric field is recovered completely when the field is removed. Real dielectrics are not perfect, and only part of the stored electric energy is recovered. The remainder is lost as heat. The power factor is a measure of the proportion of the stored energy that is lost. It is analogous to the normal electric resistance of the capacitor. The total energy lost depends on the frequency of the electric field, i.e. the rate of charging and discharging the capacitor. It also depends on the amount of energy stored each cycle, which depends on the capacitance. The product of the power factor and the capacitance is known as the loss factor. **Power-loss meters** are based on the relationship between the loss factor of wood and its moisture content.

The power factor of wood generally increases with increasing moisture content, but it is a complex relationship that also depends on temperature, frequency and wood density. The loss factor, which is the product of power factor and capacitance, generally increases with both increasing moisture content and increasing wood density.

Power-loss meters operate by applying an electric field to the wood from an electrode. The power absorbed by the wood loads the oscillator in the meter, and reduces the amplitude of oscillation. The reduction is shown on the meter dial - either in arbitrary units, or units of % wood moisture content using an assumed relationship between power-loss and moisture content.

Capacitance admittance meters are another type that measure dielectric properties of wood. They measure the effect of both capacitance and loss factor. The electrode is a capacitative element in a capacitance-resistance bridge circuit. When it is placed in contact with the wood being tested its capacitance and loss factor increases, unbalancing the circuit. The amount of imbalance provides a measure of both the dielectric constant and the power factor of the wood, and is displayed to provide the meter reading. Some meters of this type are more influenced by the dielectric constant than the power factor.

(ii) Effect of species and density

The most important practical effect on the readings of dielectric meters (other than moisture content) is the density of the wood. Readings increase with increasing density. The main effect of species (apart from a few exceptional cases) is actually the effect of differences in density. The meter manufacturer should supply the information necessary to correct meter readings for the density and species effect. However, it will often be necessary for the meter user to establish the calibration required for a particular application, by comparing meter readings on representative samples with the moisture content determined by oven-drying.

There is considerable normal density variation within many species. This imposes a natural limit to the accuracy of dielectric meters. Some idea of the size of the effect can be obtained from sampling a range of material from the same species and comparing meter readings with the results of oven drying.

(iii) Effect of temperature

The effect of wood temperature on the readings of dielectric meters is more complicated than the effect on resistance meters. The manufacturer should supply information about the reference temperature of the meter, and any necessary corrections to be made for different wood temperatures, or differences between wood temperature and meter temperature. In some cases it may be necessary for the meter user to establish the appropriate calibration.

The calibration setting of a meter may vary if its temperature changes. This may happen if it is used for repeated readings on warm wood. In these circumstances, the calibration setting should be checked regularly.

(iv) Effect of grain direction

The orientation of the electric field in relation to the direction of the grain can affect the readings of dielectric meters. The effect is usually not large for meter electrodes applied to surfaces that are parallel to the direction of the grain, which is normally the case. However, it may be considerable if the electrodes are applied to end-grain surfaces.

The electrodes of some dielectric meters are circular in format or construction. This symmetry eliminates any effect of grain direction when they are used on side-grain surfaces. Other meters have electrodes that consist of parallel rectangular plates, separated by a gap or gaps. They should be used with the electrodes oriented with respect to the grain in the direction advised by the manufacturer. This is usually with the length of the plates and gap(s) parallel to the grain.

(v) Effect of preservatives

Water-borne preservatives or fire retardants in wood are likely to increase both its dielectric constant and its loss factor. The readings of dielectric meters on wood treated with these materials are likely to be erroneously high.

(vi) Effect of surface coatings and finishes

Most polishes and surface finishes used on wood have no effect on the readings of dielectric meters. One advantage of these meters is that they can usually be used on finished surfaces without marking them.

(vii) Meters and their use

Different makes of meters are available. They fall into the three types - capacitance, power-loss and capacitance admittance - that are discussed in section (i) under "Dielectric meters". Each has an electrode system that is an integral part of the meter, and is not interchangeable. Different electrodes cannot be used for different applications, as they can with resistance meters.

A dielectric meter for measuring the moisture content of veneer is shown in Plate 6.

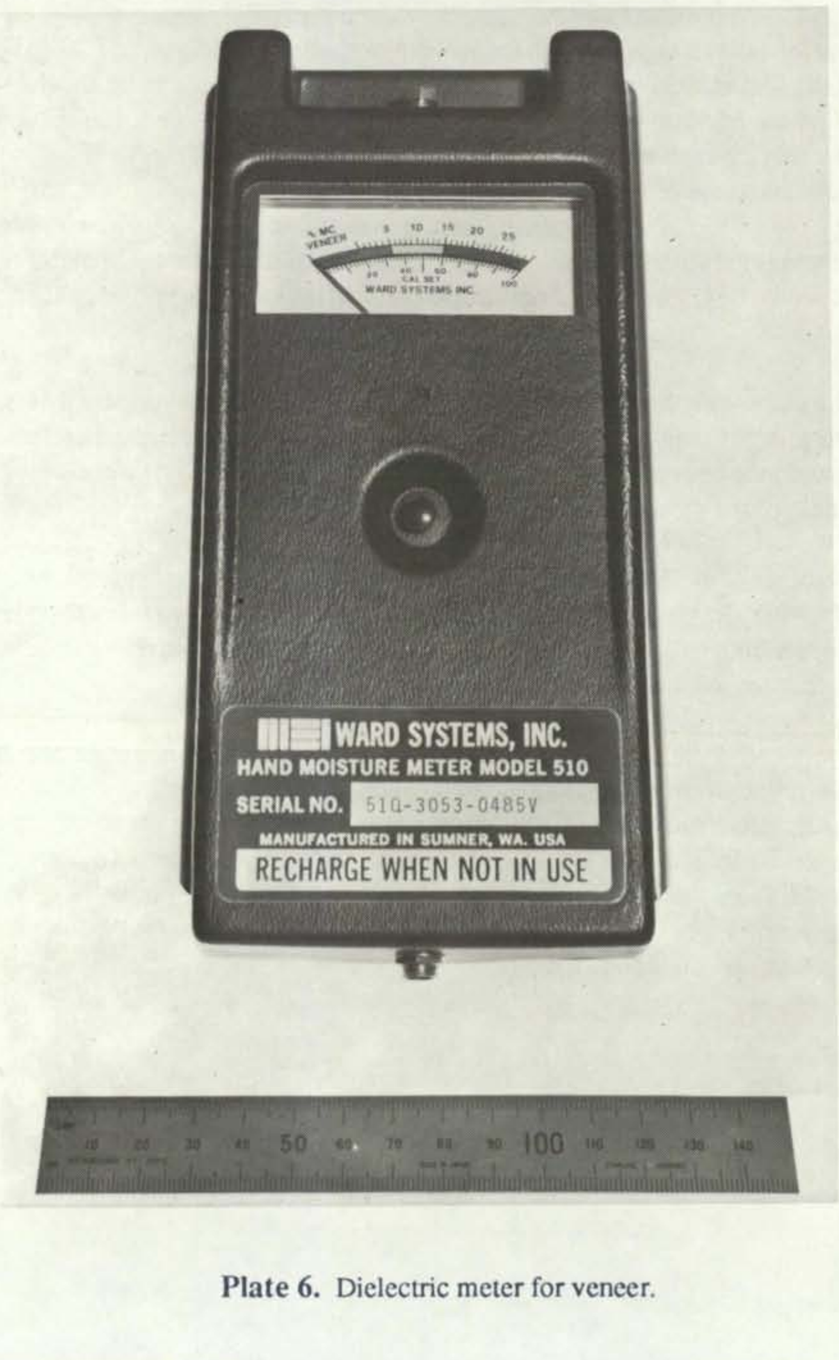

Plate 6. Dielectric meter for veneer.

There are a number of different forms of meter electrode. For any particular application the electrode type must provide consistent firm contact with the surface of the timber being tested. The actual form and size of the electrode depends on the meter type, the application, and the depth of field penetration.

The field penetrations of different meters can range from a few millimeters, in meters designed for testing veneer, to about 50 mm in meters for testing thick timber. The meter used should have an appropriate field penetration, which should normally be at least half the thickness of the timber being tested.

Dielectric meters measure mean moisture content, and are not suitable for determining moisture gradients. They respond to the moisture content of the zone of the wood that is penetrated by the electric field, and will generally indicate the mean moisture content of this zone. However, the readings are most influenced by the wood nearest the electrode, so they are more reliable on wood with a fairly uniform moisture content than readings on wood with substantial moisture gradients. If the moisture content near the surface is higher than the mean, the meter reading will be higher than the true mean moisture content. The converse occurs in situations of high interior moisture contents, or 'wet cores'.

If the field of the meter extends right through the wood, the reading is likely to be affected by the material behind it, particularly if it is metal or other high loss material. The effect can be checked by comparing readings on wood on the backing material with readings with nothing (except air) behind the wood. A difference indicates that the reading is affected by the backing material. The effect can be eliminated by using an appropriate thickness of low loss backing, such as rigid polystyrene foam. An alternative is to take readings on pieces on top of a stack of similar material with similar moisture content. This may be the most convenient method with thin material, such as veneer. If this is done, the meter reading is likely to be higher than it would be if taken on a single thickness, and the meter should be calibrated for this type of application.

Readings should be taken with the whole electrode in firm contact with the surface of sound wood that is free of defects such as decay, knots, holes, gum or resin veins, etc. If possible, the meter should be located so that there is a clearance between the electrode and the edge of the piece of wood being tested at least equal to the thickness of the piece.

One important advantage of dielectric meters is that they can read down to zero moisture content, although their accuracy falls at very low moisture contents. Power-loss meters can provide accurate readings up to about 15 to 30%, depending on species. Capacitance and capacitance admittance meters can read higher moisture contents, but are most accurate below about 30%.

As with resistance meters, dielectric meters should be used in accordance with the manufacturer's instructions, and the reliability of the results depends on the adequacy of sampling. Several readings should be taken at separate locations on a number of representative pieces to provide an estimate of mean moisture content of the individual pieces and the parcel, and the piece-to-piece variation. In most applications it will be necessary to establish the meter calibration by comparing readings on representative samples with the moisture content determined by oven-drying. Ongoing comparative testing will be required to maintain the calibration in routine production situations.

(viii) Application of dielectric meters

Dielectric meters are generally not as accurate as resistance meters, and do not have as wide a general application. However, they do have some advantages -

- Their electrode contact is non-penetrating and the meters can be used on most finished timber surfaces without marking them.

- They will read very low moisture contents, below the range of resistance meters.

- They can be faster and more convenient where a large number of readings are to be taken for the production line quality control monitoring of the moisture content of similar material.

CONCLUSION

The two types of electric moisture meters available - resistance and dielectric - have relative advantages and limitations. These have been discussed in detail in the section "Expression and Calculation of Moisture Content" and "Methods of Determining Moisture Content".

Resistance meters have the wider general application in normal timberyard and timber industry use. However, they will only give reliable results if their limitations are fully understood by the user, proper precautions are taken, and the appropriate corrections are applied to the meter readings.

Dielectric meters are generally more limited in their scope of application. However they have advantages over resistance meters that make them the most suitable type in some situations. It should be remembered that they are usually not as accurate as resistance meters, due to the significant effect of wood density on their readings.

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Note

The photographs of moisture meters in this paper do not imply endorsement of the particular models shown in preference to other makes and models available.

APPENDIX 1

SPECIES CORRECTION FIGURES FOR ELECTRIC RESISTANCE METERS.

Figures for resistance meters with the Australian calibration curve developed for North American coast type Douglas fir (oregon), tested at 20° to 21°C with the current flow perpendicular to the direction of the grain.

Standard Trade Names generally comply with Australian Standards AS 2543 - 1983 "Nomenclature of Australian Timbers" and AS 1148 - 1971 "Nomenclature of Commercial Timbers Imported into Australia".

Sources of information are listed at the end of the Appendix. Where different information is available from more than one source, preference has usually been given to data from the country of origin of the species.

Figures in italics are extrapolated beyond the original data.

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	Botanical Name	Source	Correct Moisture Content (%)																		
abura	*Mitragyna ciliata*	4	-	8	9	10	11	12	13	14	14	15	16	16	17	18	18	19	20	21	21
afara	*Terminalia superba*	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
afrormosia	*Pericopsis elata*	4	-	7	8	9	10	10	11	12	13	14	15	15	16	16	17	18	18	19	20
agba	*Gossweilerodendron balsamiferum*	4	-	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
albizzia, New Guinea	*Albizia falcataria*	1	7	8	9	10	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
albizzia, Solomon Is.	*A. falcataria*	1	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	17	18	19	20
alder, blush	*Sloanea australis*	1	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	19
alder, brown	*Caldcluvia paniculosa*	1	8	9	10	10	11	12	13	13	14	15	15	16	17	18	18	19	20	20	21
alder, rose	*C. australiensis*	1	7	8	9	10	10	11	12	13	13	14	15	16	16	17	18	18	19	20	21
almond, Indian (Fiji)	*Terminalia pterocarpa*	10	7	7	8	8	9	10	10	11	12	12	13	14	14	15	15	16	17	-	-
amberoi	*Pterocymbium beccarii*	1	6	7	7	8	9	9	10	11	12	12	13	14	14	15	16	17	17	18	19
amoora, New Guinea	*Amoora cucullata*	1	5	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
antiaris, New Guinea	*Antiaris toxicaria*	1	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	21	22	23
apple, black	*Planchonella australis*	1	9	9	10	10	11	12	12	13	14	14	15	15	16	17	17	18	19	19	20
ash, alpine	*Eucalyptus delegatensis*	1	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24	25
ash, American (black)	*Fraxinus nigra*	7	-	7	9	10	12	13	15	16	17	19	20	21	23	24	-	-	-	-	-
ash, American (white)	*F. americana*	7	-	7	9	10	11	13	14	15	17	18	19	20	21	23	24	-	-	-	-
ash, Bennett's	*Flindersia bennettiana*	1	7	8	9	10	11	11	12	13	14	15	15	16	17	18	19	19	20	21	22
ash, Crow's	*F. australis*	1	8	9	10	10	11	12	12	13	14	14	15	16	17	17	18	19	20	20	21
ash, European	*Fraxinus excelsior*	1	8	8	9	10	11	12	12	13	14	14	15	16	17	18	18	19	20	21	21

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	Botanical Name	Source	Correct Moisture Content (%)																		
ash, hickory	*Flindersia ifflaiana*	1	8	8	9	10	11	12	12	13	14	14	15	16	17	18	18	19	20	20	21
ash, Japanese	*Fraxinus mandshurica*	4	-	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	19	20	21
ash, mountain	*Eucalyptus regnans*	1	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24	25
ash, New Guinea silver	*Flindersia amboinensis*	1	7	8	9	10	11	11	12	13	14	15	16	17	18	19	19	20	21	22	23
ash, red	*Alphitonia excelsa*	1	6	7	8	8	9	10	11	11	12	13	14	14	15	16	16	17	18	18	19
ash, scaly	*Ganophyllum falcatum*	1	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23	24
ash, silver (northern)	*Flindersia schottiana*	1	8	9	10	10	11	12	13	13	14	15	16	16	17	18	18	19	20	20	21
ash, silver (Qld)	*F. bourjotiana*	1	8	9	10	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24
ash, silver (southern)	*F. schottiana*	1	8	9	10	11	12	13	14	15	15	16	17	18	19	20	20	21	22	23	24
ash, silvertop	*Eucalyptus sieberi*	1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
aspen (American)	*Populus grandidentata*	7	-	-	7	8	10	11	12	14	15	16	18	19	20	21	23	24	-	-	-
aspen, hard	*Acronychia laevis*	1	6	7	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19
balau (Malaysia)	*Shorea laevis*	12	*7*	*7*	*8*	*8*	*9*	*10*	*10*	*11*	*12*	13	14	15	16	17	18	19	20	23	27
balau, red (Malaysia)	*S. guiso*	12	*5*	*6*	*7*	*8*	*9*	*10*	*10*	*11*	*12*	13	14	15	16	17	18	19	20	21	21
balau, red (Philipp.)	*S. guiso*	3	-	10	11	12	12	13	14	15	16	17	17	18	19	20	21	22	22	24	24
balsa	*Ochroma pyramidale*	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Baltic, red	*Pinus sylvestris*	4	-	9	10	11	12	13	14	15	15	16	17	18	18	19	20	21	22	23	24
Baltic, white	*Picea abies*	4	-	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27
basswood, Fijian	*Endospermum macrophyllum*	10	6	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18
basswood, Malaysian	*E. malaccense*	12	*9*	*10*	*11*	*12*	*13*	14	15	17	18	19	20	22	24	30	-	-	-	-	-
basswood, New Guinea	*E. medullosum*	1	7	7	8	9	10	11	12	12	13	14	15	16	16	17	18	19	20	20	21
basswood, Solomon Is.	*E. medullosum*	1	5	6	6	7	8	9	9	10	11	11	12	13	13	14	15	16	16	17	18
basswood, silver	*Tieghemopanax elegans*	1	8	9	10	10	11	12	12	13	14	15	16	16	17	18	18	19	20	21	22
bauvudi	*Palaquium fidjiense)* *P. vitilevuense)*	10	7	7	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18	18

Standard Trade Name	Botanical Name	Source	Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Correct Moisture Content (%)																		
bean, black	*Castanospermum australe*	1	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24	25
beech, European	*Fagus sylvatica*	4	-	10	11	12	13	14	15	16	-	-	-	-	-	-	-	-	-	-	-
beech, myrtle	*Nothofagus cunninghamii*	1	7	8	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21	22
beech, silky	*Citronella moorei*	1	9	9	10	11	12	12	13	14	14	15	16	16	17	18	18	19	20	20	21
beech, silver	*Nothofagus menziesii*	1	9	9	10	10	11	12	12	13	13	14	14	15	16	16	17	17	18	19	19
beech, silver (sapwood)	*Nothofagus menziesii*	5	-	-	-	-	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
beech, Wau	*Elmerrillia papuana*	1	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
beech, white (Fiji)	*Gmelina vitiensis*	10	6	7	8	9	10	10	11	12	13	14	15	15	16	17	18	19	20	20	21
beech, white (Qld)	*G. leichhardtii*	1	7	8	9	10	11	12	13	14	14	15	16	17	18	19	19	20	21	22	23
birch, European	*Betula pubescens*	4	-	10	11	12	13	14	15	16	-	-	-	-	-	-	-	-	-	-	-
birch, paper	*B. papyrifera*	7	-	-	-	8	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24
birch, white	*Schizomeria ovata*	1	8	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20	21	22	22
birch, yellow	*Betula lutea*	4	-	8	9	10	11	12	13	14	14	15	16	16	17	18	18	19	20	21	21
bishop wood (Fiji)	*Bischofia javanica*	10	6	7	8	8	9	10	11	12	12	13	14	15	16	16	17	18	19	19	20
blackbutt	*Eucalyptus pilularis*	1	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
blackbutt, Western Australian	*Eucalyptus patens*	1	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	24	25
blackwood	*Acacia melanoxylon*	1	8	9	9	10	11	12	12	13	14	15	16	16	17	18	19	20	20	21	22
bloodwood, red	*Eucalyptus gummifera*	1	9	10	10	11	12	13	14	15	15	16	17	18	19	19	20	21	22	23	23
bollywood	*Litsea reticulata*	1	7	7	8	9	10	11	12	12	13	14	15	16	16	17	18	19	20	21	22
box, black	*Eucalyptus largiflorens*	1	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
box, brush (N.S.W.)	*Tristania conferta*	1	5	6	7	7	8	8	9	9	10	11	11	12	12	13	14	14	15	15	16
box, brush (Qld)	*T. conferta*	1	7	8	8	9	9	9	10	10	11	11	12	12	13	13	14	14	14	15	15
box, brush	*T. conferta* (source unknown)	8	6	7	7	8	8	9	9	10	10	11	11	12	13	13	14	14	15	15	16
box, grey	*Eucalyptus moluccana*	1	9	10	11	12	12	13	14	14	15	16	17	17	18	19	20	20	21	22	23

Standard Trade Name	Botanical Name	Source	Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Correct Moisture Content (%)																		
box, grey, coast	*E. bosistoana*	1	8	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21	22	22
box, kanuka	*Tristania laurina*	1	8	8	9	10	11	12	12	13	14	15	16	16	17	18	19	20	20	21	22
boxwood, New Guinea	*Xanthophyllum papuanum*	1	7	7	8	9	9	10	11	12	12	13	14	15	15	16	17	17	18	19	20
boxwood, yellow	*Planchonella pohlmaniana*	1	9	9	10	10	11	12	12	13	14	14	15	15	16	17	17	18	19	19	20
brachychiton, New Guinea	*Brachychiton carruthersii*	1	6	7	7	8	8	9	9	10	11	11	12	12	13	13	14	15	-	-	-
bridelia	*Bridelia minutiflora*	1	7	8	9	10	12	13	14	15	16	17	18	19	21	22	23	24	25	26	27
brigalow	*Acacia harpophylla*	1	7	8	9	10	11	11	12	13	14	15	16	17	18	19	20	20	21	22	23
brownbarrel	*Eucalyptus fastigata*	1	6	7	8	9	10	11	12	12	13	14	15	16	17	18	18	19	20	21	22
buchanania	*Buchanania arborescens*	1	5	6	7	8	9	10	10	11	12	13	14	14	15	16	17	18	19	19	20
buabua	*Fagraea gracilipes*	10	5	6	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	19	21
burckella, Solomon Is.	*Burckella obovata*	1	5	6	6	7	8	8	9	9	10	11	11	12	13	13	14	-	-	-	-
butternut, ros	*Blepharocarya involucrigera*	1	6	7	8	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19	19
calophyllum, beach (Philippines)	*Calophyllum inophyllum*	3	-	8	9	10	11	11	12	13	14	15	16	16	17	18	19	20	21	21	22
calophyllum, Fijian	*C. leucocarpum)* *C. vitiense)*	10	7	8	9	10	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23
calophyllum, Malaysian	*C. curtisii*	12	7	*8*	*9*	*10*	10	11	12	13	14	15	16	16	17	18	18	19	20	21	22
calophyllum, New Guinea	*C. papuanum*	1	6	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23	24	26
calophyllum, Solomon Is.	*Calophyllum kajewskii)* *C. vitiense)*	1	6	6	7	8	9	10	10	11	12	13	14	14	15	16	17	18	18	19	20
camphorwood, New Guinea	*Cinnamomum* spp.	1	7	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19	20	21	21
campnosperma (Malaysia)	*Campnosperma auriculata*	12	*10*	*11*	*12*	*13*	*14*	*15*	*16*	17	18	19	20	21	22	23	24	25	26	27	28
campnosperma (N.G.)	*C. brevipetiolata*	1	6	7	8	9	10	10	11	12	13	14	15	16	16	17	18	19	20	20	21
campnosperma (Solomon Is.)	*C. brevipetiolata*	1	4	5	6	7	8	8	9	10	11	12	13	14	14	15	16	17	18	19	20

Standard Trade Name	Botanical Name	Source	Meter Reading (Moisture Content %) 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Correct Moisture Content (%)																		
cananga (Philippines)	*Canangium odoratum*	3	-	9	10	11	11	12	12	13	14	14	15	16	16	17	18	18	19	19	20
canarium, African	*Canarium schweinfurthii*	4	-	9	10	11	12	13	14	15	15	16	17	18	18	19	20	21	22	23	24
canarium, New Guinea	*C. oleosum*	1	6	7	8	9	9	10	11	12	13	13	14	15	16	17	17	18	19	20	21
canarium, Fijian	*C. vitiense)* *C. vanikoroense)*	10	6	7	8	9	10	11	11	12	13	14	15	16	16	17	18	19	20	20	21
canarium, Solomon Is.	*Canarium salomonense*	1	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15	16	16	17	18
candlenut (Philippines)	*Aleurites moluccana*	3	-	5	8	10	12	14	16	18	21	23	25	27	29	31	34	36	38	40	42
carabeen, yellow	*Sloanea woollsii*	1	7	8	9	9	10	11	12	12	13	14	14	15	16	16	17	18	18	19	20
cathormion, New Guinea	*Cathormion umbellatum*	1	5	6	6	7	8	8	9	9	10	10	11	12	12	13	-	-	-	-	-
cedar, red	*Toona australis*	1	8	9	10	11	12	13	14	16	17	18	19	20	21	22	23	25	26	27	27
cedar, western red	*Thuja plicata*	2	-	-	8	9	9	10	11	12	13	14	15	16	17	17	18	19	20	21	22
cedar, white	*Melia azedarach*	1	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24	24
cedar, yellow	*Chamaecyparis nootkatensis*	2	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
celtis, New Guinea	*Celtis nymanni & Celtis* spp.	1	7	7	8	9	9	10	11	12	12	13	14	14	15	16	17	17	18	19	19
celtis, Solomon Is.	*Celtis philippinensis*	1	5	6	7	7	8	8	9	9	10	11	11	12	12	13	14	-	-	-	-
cheesewood, white (New Guinea)	*Alstonia scholaris*	1	7	8	9	9	10	11	12	13	13	14	15	16	16	17	18	19	20	20	21
cheesewood, white (Philippines)	*A. scholaris*	3	-	9	10	11	12	13	13	14	15	16	17	17	18	19	20	20	21	22	23
cheesewood, white (Qld)	*A. scholaris*	1	6	7	8	9	10	10	11	12	13	14	15	15	16	17	18	19	20	20	21
cheeesewood, white (Solomon Is.)	*A. scholaris*	1	5	6	7	7	8	9	10	10	11	12	12	13	14	15	15	16	17	17	18
chengal (Malaysia)	*Neobalanocarpus heimii*	12	*6*	*6*	*7*	*8*	*9*	*10*	*11*	11	12	13	14	15	16	16	17	18	19	20	20
cherry (Europe)	*Prunus avium*	4	-	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
cleistocalyx	*Cleistocalyx myrtoides*	1	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24
coachwood	*Ceratopetalum apetalum*	1	5	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22
coconut	*Cocos nucifera*	10	-	-	-	-	8	8	9	9	10	11	11	12	12	13	13	13	14	14	15
coondoo, blush	*Planchonella laurifolia*	1	6	7	8	9	10	10	11	11	12	12	13	14	14	15	15	16	17	17	18

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
cordia, New Guinea	*Cordia dichotoma*	1	6	7	7	8	8	9	9	10	10	11	11	12	12	13	14	-	-	-	-
corkwood, grey	*Erythrina vespertilio*	1	7	8	9	9	10	10	11	12	12	13	13	14	14	15	15	16	17	17	18
cudgerie, brown	*Canarium australasicum*	1	8	9	10	11	11	12	13	13	14	15	15	16	17	17	18	19	19	20	21
dacrydium, New Zealand (heartwood)	*Dacrydium cupressinum*	5	-	-	-	-	11	11	12	12	12	13	13	13	14	14	15	15	16	16	17
dacrydium, New Zealand (sapwood)	*D. cupressinum*	5	-	-	-	-	12	12	13	14	15	16	16	17	18	19	19	20	20	21	21
dakua, salusalu (Fiji)	*Decussocarpus vitiensis*	10	8	9	10	11	11	12	13	14	15	16	17	18	19	19	20	21	22	23	24
dillenia (Solomon Is.)	*Dillenia salomonense*	1	6	6	7	8	8	9	10	10	11	12	13	13	14	15	15	16	17	17	18
doi (Fiji)	*Alphitonia zizyphoides*	10	6	7	7	8	9	10	10	11	12	13	14	14	15	16	17	17	18	19	20
drypetes, New Guinea	*Drypetes* spp.	1	8	9	10	10	11	11	12	13	13	14	15	15	16	16	17	18	18	19	20
duabanga, New Guinea	*Duabanga moluccana*	1	6	6	7	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19	20
ebony, New Guinea Indian	*Diospyros* spp.	1	7	8	8	9	9	10	10	11	12	12	13	13	14	14	15	16	16	-	-
elm, European	*Ulmus* spp.	4	-	8	9	10	11	12	13	14	14	15	16	16	17	18	18	19	20	21	21
elm, white	*U. americana*	7	-	7	9	11	13	14	16	17	18	20	21	22	24	-	-	-	-	-	-
erima	*Octomeles sumatrana*	1	7	8	8	9	10	11	12	12	13	14	15	15	16	17	18	19	19	20	21
erima (Philippines)	*O. sumatrana*	3	-	6	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	18	19
evodia, white	*Euodia micrococca*	1	6	7	8	8	9	9	10	11	11	12	13	13	14	14	15	16	16	17	18
figwood (Moreton Bay)	*Ficus macrophylla*	1	7	8	9	10	10	11	11	12	12	13	13	14	14	15	16	16	17	17	18
fir, alpine	*Abies lasiocarpa*	2	8	8	9	10	11	12	13	14	15	15	16	17	18	19	20	20	21	22	23
fir, amabilis	*A. amabilis*	2	-	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
fir, Douglas (N.Z.) (sapwood)	*Pseudotsuga menziesii*	5	-	-	-	-	12	13	14	15	16	18	19	20	21	22	24	25	26	27	28
fir, Douglas (N.Z.) (heartwood)	*P. menziesii*	5	-	-	-	-	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25
fir, Douglas	*P. menziesii*	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	Botanical Name	Source	Correct Moisture Content (%)																		
fir, Douglas (Canada) (coastal)	*P. menziesii*	2	7	8	9	10	11	12	13	14	15	16	17	18	19	20	20	21	22	23	24
fir, Douglas (Canada) (interior)	*P. menziesii*	2	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
fir, Douglas (Canada)	*P. menziesii*	1	7	8	9	10	11	12	12	13	14	15	16	17	18	18	19	20	21	22	23
fir, Douglas (Victoria)	*P. menziesii*	1	8	9	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
fir, grand	*Abies grandis*	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
galip	*Canarium indicum*	1	7	7	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18	19
garawa	*Anisoptera polyandra*	1	6	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20
garo-garo	*Mastixiodendron pachyclados*	1	6	7	8	8	9	10	11	11	12	13	13	14	15	16	16	17	18	18	19
garuga	*Garuga floribunda*	1	7	8	8	9	9	10	10	11	12	12	13	13	14	14	15	15	16	16	17
giam	*Hopea iriana*	1	8	9	10	11	12	13	14	15	16	16	17	18	19	20	22	23	25	27	28
greenheart	*Ocotea rodiaei*	4	-	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27
greenheart, Queensland	*Endiandra compressa*	1	9	10	11	12	12	13	14	15	16	17	18	18	19	20	21	22	23	24	24
guarea, scented (black)	*Guarea cedrata*	4	-	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
guarea, scented (white)	*G. cedrata*	4	-	11	12	12	13	14	14	15	16	16	17	17	18	18	19	20	21	22	23
gum, blue, southern	*Eucalyptus globulus*	1	7	8	9	10	11	12	12	13	14	15	16	17	17	18	19	20	21	22	22
gum, blue, Sydney	*E. saligna*	1	8	9	10	11	12	12	13	14	15	15	16	17	18	19	19	20	21	22	23
gum, grey	*E. punctata*	1	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
gum, grey, mountain	*E. cypellocarpa*	1	8	9	9	10	11	12	13	14	14	15	16	17	18	19	19	20	21	22	23
gum, lemon-scented	*E citriodora*	10	6	6	7	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19	20
gum, Maiden's	*E. maidenii*	1	9	10	11	11	12	13	14	15	16	16	17	18	19	20	20	21	22	23	24
gum, manna	*E. viminalis*	1	6	7	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	21
gum, mountain	*E. dalrympleana*	1	6	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
gum, pink	*E. fasciculosa*	1	8	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24
gum, red, forest	*E. tereticornis*	1	9	10	11	12	12	13	14	15	16	17	18	18	19	20	21	22	23	24	24

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	Botanical Name	Source	Correct Moisture Content (%)																		
gum, red, river	*E. camaldulensis*	1	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
gum, rose	*E. grandis*	1	8	9	10	11	12	13	14	14	15	16	17	18	18	19	20	21	22	23	24
gum, shining	*E. nitens*	1	7	8	9	10	11	11	12	13	14	15	16	17	18	19	20	20	21	22	23
gum, spotted (N.S.W.)	*E. maculata*	1	7	8	8	9	9	10	10	11	12	12	13	13	14	14	15	15	16	17	-
gum, spotted (lemon-scented)	*E. citriodora*	1	6	6	7	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19	20
gum, spotted (Vic.)	*E. maculata*	1	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20	21
gum, sugar	*E. cladocalyx*	1	8	9	10	10	11	12	13	14	15	16	16	17	18	19	20	20	21	22	23
gum, white, Dunn's	*E. dunnii*	6	5	6	7	8	9	9	10	11	12	12	13	14	15	16	16	17	18	19	19
gum, yellow	*E. leucoxylon*	1	9	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20	21	21	22
handlewood, grey	*Aphananthe philippinensis*	1	6	7	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19
handlewood, white	*Streblus pendulinus*	1	8	9	9	10	10	11	12	12	13	13	14	14	15	16	16	17	17	18	19
hardwood, Johnstone River	*Backhousia bancroftii*	1	6	6	7	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19	20
hemlock, Taiwan	*Tsuga chinensis*	1	7	8	8	9	10	11	11	12	13	13	14	15	16	16	17	18	18	19	20
hemlock, western	*T. heterophylla*	2	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22	23	24	26	27
heritiera, New Guinea	*Heritiera littoralis*	1	6	7	8	8	9	10	10	11	12	13	13	14	15	15	16	17	18	18	19
hickory	*Carya* spp.	7	-	-	7	9	11	13	14	16	17	18	20	21	22	24	-	-	-	-	-
hollywood, yellow	*Premna lignum-vitae*	1	9	9	10	11	11	12	13	13	14	15	16	16	17	18	18	19	20	20	21
horizontal	*Anodopetalum biglandulosum*	1	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	22	23	24
incensewood	*Pseudocarapa nitidula*	1	9	9	10	10	11	12	12	13	13	14	14	15	16	16	17	17	18	19	19
iroko	*Chlorophora excelsa*	2	-	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	19	20	21
ironbark, grey	*Eucalyptus drepanophylla*	1	9	10	11	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25
ironbark, grey	*E. paniculata*	1	7	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23	24
ironbark, red	*E. sideroxylon*	1	10	11	12	12	13	14	15	16	16	17	18	19	20	21	22	22	23	24	24
ironbark, red, broad-leaved	*E. fibrosa*	1	10	11	12	12	13	14	15	16	16	17	18	19	20	21	22	22	23	24	25

Standard Trade Name	Botanical Name	Source	Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Correct Moisture Content (%)																		
ironbark, red, narrow-leaved	*E. crebra*	1	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22	23	24
jarrah	*E. marginata*	1	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
jelutong (Malaysia)	*Dyera costulata*	12	-	-	-	-	7	8	9	10	11	12	13	14	16	17	18	20	21	22	24
kamarere (Fiji)	*Eucalyptus deglupta*	10	6	7	8	8	9	10	11	11	12	13	13	14	15	15	16	17	17	18	19
kamarere (N.G.)	*E. deglupta*	1	7	8	9	10	10	11	12	13	14	15	16	17	18	19	19	20	21	22	23
kapur, Malaysian	*Dyrobalanops aromatica*	12	-	3	4	5	6	7	7	8	9	10	11	12	13	14	15	16	17	17	18
karri	*Eucalyptus diversicolor*	1	7	7	8	9	10	11	12	13	13	14	15	16	17	18	18	19	20	21	22
kauceti	*Kermadecia vitiensis*	10	6	6	7	8	8	9	9	10	11	11	12	12	13	14	14	15	-	-	-
kauri, East Indian (Malaysia)	*Agathis borneensis*	12	6	6	7	7	8	9	9	10	11	12	13	14	16	17	19	20	21	22	24
kauri, Fijian	*A. vitiensis*	10	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
kauri, New Zealand	*A. australis*	1	8	9	10	10	11	12	12	13	13	14	14	15	16	16	17	17	18	18	19
kauri, Vanikoro	*A. macrophylla*	1	10	11	12	13	13	14	14	15	15	15	16	16	17	17	18	18	18	19	19
keledang (Malaysia)	*Artocarpus lanceifolius*	12	5	6	7	8	10	11	13	14	16	18	20	21	22	24	26	30	-	-	-
kempas, Malaysian	*Koompassia malaccensis*	12	8	8	9	9	10	11	12	13	14	15	16	17	18	19	21	24	27	-	-
kempas, Malaysian	*K. excelsa*	12	7	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
keranji (Malaysia)	*Dialium platysepalum*	12	-	-	-	-	7	8	9	10	12	13	14	15	17	18	19	23	24	26	28
keruing, Malaysian	*Dipterocarpus crinitus*	12	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
keruing, Malaysian	*D. kerrii*	12	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	22	-	-
keruing, Philippine	*D. grandiflorus*	3	-	8	9	10	11	11	12	13	14	15	15	16	17	18	19	19	20	21	22
keruing, Philippine	*D. warburgii*	3	-	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	23	23	24
keruing, Philippine	*D. gracilis*	3	-	7	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	23
kiso	*Chisocheton schumannii*	1	7	8	8	9	9	10	10	11	11	12	12	13	14	14	15	15	16	-	-

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	Botanical Name	Source	Correct Moisture Content (%)																		
kwila (Fiji)	*Intsia bijuga*	10	7	8	9	10	10	11	12	13	14	14	15	16	17	18	18	19	20	21	21
kwila (Malaysia)	*I. palembanica*	12	*7*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	14	15	16	16	17	18	19	20	21	22	23
kwila (Malaysia)	*I. palembanica*	1	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24	25
lacewood, yellow	*Polyalthia oblongifolia*	1	6	7	8	9	9	10	11	11	12	13	14	14	15	16	16	17	18	19	19
laran	*Anthocephalus chinensis*	1	7	8	8	9	10	11	11	12	13	14	14	15	16	17	17	18	18	19	19
larch, Japanese	*Larix kaempferi*	4	-	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27
larch, western	*L. occidentalis*	2	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
leatherwood	*Eucryphia lucida*	1	8	9	10	10	11	12	13	14	15	15	16	17	18	19	20	20	21	22	23
lightwood	*Acacia implexa*	1	8	9	9	10	11	11	12	12	13	14	14	15	16	16	17	18	18	19	19
lime, American	*Tilia americana*	4	-	7	8	9	10	10	11	12	-	-	-	-	-	-	-	-	-	-	-
lime, European	*Tilia vulgaris*	4	-	7	7	8	9	10	11	12	13	14	15	15	16	17	18	18	19	20	21
lumbayau (Malaysia)	*Heritiera javanica*	12	-	-	-	-	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
macadamia	*Macadamia praealta*	1	9	9	10	10	11	12	12	13	13	14	14	15	16	16	17	18	18	19	19
mahogany, African	*Khaya* spp.	4	-	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
mahogany, American	*Swietenia* spp.	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
mahogany, American (Malaysia)	*Sweitenia macrophylla*	12	-	-	-	-	10	10	11	12	13	14	15	16	17	18	19	20	21	22	23
mahogany, American (Fijian)	*S. macrophylla*	10	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
mahogany, brush	*Geissois benthamii*	1	8	8	9	10	10	11	11	12	12	13	14	14	15	15	16	16	17	18	18
mahogany, miva	*Dysoxylum muelleri*	1	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20	20	21	22	23
mahogany (N.G.)	*Dysoxylum* spp.	1	8	9	9	10	11	12	12	13	14	15	16	16	17	18	19	19	20	21	22
mahogany, Philippine light red	*Shorea almon*	3	-	8	9	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20	21

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
mahogany, Philippine light red	*Parashorea plicata*	3	-	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
mahogany, Philippine light red	*Pentacme contorta*	3	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
mahogany, Philippine light red	*Shorea squamata*	3	-	9	9	10	11	12	12	13	14	15	15	16	17	17	18	19	20	20	21
mahogany, Philippine light red (Malaysia)	*Parashorea densiflora*	12	*8*	*9*	*10*	*10*	*11*	*12*	*13*	14	15	16	17	19	21	22	23	25	28	29	30
mahogany, Philippine red	*Shorea negrosensis*	3	-	8	9	10	11	12	13	14	15	16	17	18	19	20	21	21	22	23	24
mahogany, Philippine red	*S. polysperma*	3	-	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	21	22	23
mahogany, red	*Eucalyptus resinifera*	1	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24	25	26
mahogany, rose	*Dysoxylum fraseranum*	1	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19	20	20
mahogany, southern	*Eucalyptus botryoides*	1	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	20	21	22	23
mahogany, white	*E. acmenoides*	1	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
mako	*Trichospermum richii*	10	5	5	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	17	18
makore	*Tieghemella heckelii*	4	-	9	10	11	12	13	14	15	15	16	17	18	18	19	20	21	22	23	24
malas	*Homalium foetidum*	1	6	7	8	9	9	10	11	12	12	13	14	15	15	16	17	18	19	19	20
malletwood	*Rhodamnia argentea*	1	6	7	8	9	10	10	11	12	13	13	14	15	15	16	17	17	18	19	19
malletwood, brown	*R. rubescens*	1	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	17	18	19	20
manggachapui	*Hopea acuminata*	3	-	9	9	10	11	12	13	14	15	16	17	18	19	20	21	22	22	23	24
mango	*Mangifera minor*	1	6	7	7	8	9	10	10	11	12	12	13	14	15	15	16	17	18	18	19
mango (Philippines)	*M. altissima*	3	-	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	26
mangosteen (Fiji)	*Garcinia myrtifolia*	10	7	7	8	9	10	10	11	12	12	13	14	15	15	16	17	17	18	19	20
mangrove, cedar	*Xylocarpus australasicus*	1	8	9	10	11	12	12	13	14	15	16	17	18	18	19	20	21	22	23	24
manilkara	*Manilkara kanosiensis*	1	5	6	7	7	8	9	9	10	11	12	12	13	14	14	15	16	16	17	18

			Meter Reading (Moisture Content %)																		
			6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
maniltoa (Fiji)	*Cynometra insularis)* *Maniltoa grandiflora)* *M. minor)*	10	7	7	8	9	9	10	10	11	12	12	13	13	14	15	15	16	16	17	18
maniltoa (N.G.)	*M. psilogyne*	1	7	7	8	9	9	10	10	11	12	12	13	13	14	15	15	16	16	17	18
mansonia	*Mansonia altissima*	4	-	9	10	11	12	13	14	15	15	16	17	18	18	19	20	21	22	23	24
maple (Canada)	*Acer* spp.	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
maple, New Guinea	*Flindersia pimenteliana*	1	7	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24
maple, Queensland	*F. brayleyana*	11	7	9	10	12	13	14	16	17	18	20	-	-	-	-	-	-	-	-	-
maple, rose	*Cryptocarya erythroxylon*	1	7	8	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19
maple, scented	*Flindersia laevicarpa*	1	8	9	10	10	11	12	13	14	15	16	17	18	19	20	21	22	22	23	24
maple, sugar	*Acer saccharum*	7	-	-	7	8	10	12	13	14	15	16	17	18	19	20	21	22	23	24	-
mararie	*Pseudoweinmannia lachnocarpa*	1	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21	21	22	23
marri	*Eucalyptus calophylla*	1	7	7	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18	19
masiratu	*Degeneria vitiensis*	10	6	7	8	8	9	10	11	11	12	13	13	14	15	16	16	17	18	18	19
matai	*Podocarpus spicatus*	1	8	9	9	10	11	12	12	13	14	15	16	16	17	18	18	19	20	21	22
meranti, dark red (Malaysia)	*Shorea curtisii*	1	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	24	27	-	-
meranti, dark red	*S. pauciflora* (Malaysia)	1	8	9	10	12	13	14	15	17	18	19	20	21	23	24	25	-	-	-	-
meranti, dark red (Malaysia)	*Shorea sinkawang*	12	*10*	*11*	*12*	*13*	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
meranti, dark red (Malaysia)	Shorea spp.	12	*6*	*7*	*8*	*9*	*10*	*11*	*11*	*12*	13	14	15	16	17	18	19	20	21	21	22
meranti, light red (Malaysia)	*S. acuminata*	1	8	9	10	11	12	13	15	16	17	18	19	21	22	23	25	-	-	-	-

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
meranti, light red (Malaysia)	*S. macroptera*	12	*7*	*7*	*8*	*9*	*9*	10	11	12	13	14	15	16	18	20	22	24	26	27	28
meranti, light red (Malaysia)	*S. leprosula*	12	*5*	*6*	*7*	*8*	*9*	*10*	*10*	11	12	13	14	15	15	16	17	18	19	20	20
meranti, light red (Malaysia)	*S. uliginosa*	12	*9*	*10*	*11*	*11*	*12*	*13*	*14*	*15*	16	17	18	19	20	21	22	24	26	30	-
meranti, white (Indonesia)	*Shorea* spp.	1	8	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21	21	22
meranti, white (Malaysia)	*Shorea* spp.	6	*7*	*8*	*9*	*10*	*11*	*13*	*14*	*15*	16	17	18	19	21	22	23	24	25	26	27
meranti, white (Malaysia)	*S. hypochra*	12	*7*	*8*	*8*	*9*	*10*	*10*	*11*	*12*	*13*	14	15	16	17	19	20	21	22	24	27
meranti, yellow (Malaysia)	*Shorea* spp.	6	-	-	*6*	*8*	*9*	*11*	*13*	*14*	*16*	18	19	21	23	25	26	28	30	31	33
meranti, yellow (Malaysia)	*S. multiflora*	12	-	-	*3*	*4*	*5*	*6*	*7*	*7*	9	11	13	15	17	18	18	19	20	21	-
merawan	*Hopea sulcala*	12	*6*	*7*	*8*	*9*	10	12	13	14	14	15	16	17	18	19	20	21	22	23	24
mersawa, Malaysian	*Anisoptera laevis*	12	*6*	*7*	*8*	*9*	*10*	*11*	*12*	13	14	15	16	17	18	19	21	22	23	24	25
mersawa, Philippine	*A. surea*	4	-	10	10	11	12	12	13	14	14	15	16	16	17	18	19	19	20	21	21
messmate	*Eucalyptus obliqua*	1	9	10	11	12	12	13	14	15	16	16	17	18	18	19	20	21	22	22	23
messmate (immature)	*E. obliqua*	1	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
moustiquaire	*Cryptocarya* spp.	1	6	7	8	8	9	10	11	12	13	13	14	15	16	17	18	18	19	20	21
musizi	*Maesopsis eminii*	4	-	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
neuburgia	*Neuburgia collina*	1	8	9	10	11	11	12	13	14	15	15	16	17	18	18	19	20	21	22	22

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
nutmeg (Fiji)	*Myristica* spp.	10	7	7	8	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21
nutmeg (N.G.)	*M. buchneriana*) *Horsfieldia irya*)	1	7	8	8	9	10	11	12	13	13	14	15	16	17	18	18	19	20	21	22
nyatoh (Malaysia)	*Palaquium* spp.	12	5	6	7	8	9	10	12	14	15	16	16	17	18	21	23	25	28	30	-
nyatoh (Malaysia)	*Madhuca utilis*	12	*9*	*10*	*11*	*11*	*12*	*13*	14	15	16	17	18	19	20	21	22	23	24	24	25
nyatoh (Philippines)	*M. oblongifolia*	3	-	10	10	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19
oak, American red	*Quercus* spp.	7	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
oak, American white	*Quercus* spp.	7	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
oak, European	*Quercus* spp.	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
oak, Japanese	*Quercus* spp.	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
oak, New Guinea	*Castanopsis acuminatissima*	1	7	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
oak, silky, fishtail	*Neorites kevediana*	11	5	5	6	7	7	8	9	9	10	10	11	12	12	13	14	14	15	16	16
oak, silky, northern	*Cardwellia sublimis*	1	7	8	8	9	10	11	12	13	14	15	16	17	17	18	19	20	21	22	23
oak, silky, red	*Stenocarpus salignus*	1	7	8	9	9	10	11	11	12	13	13	14	15	16	16	17	18	18	19	20
oak, silky, southern	*Grevillea robusta*	1	7	7	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18	19
oak, silky, white	*Stenocarpus sinuatus*	1	7	8	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18	19	19
oak, tulip, blush	*Argyrodendron actinophyllum*	1	8	8	9	9	10	11	11	12	12	13	14	14	15	16	16	17	17	18	19
oak, tulip, brown	*A. trifoliolatum*	1	10	10	11	12	12	13	13	14	14	15	16	16	17	18	18	19	19	20	20
oak, tulip, red	*A. peralatum*	1	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24	25	25	26
oak, white tulip	*Pterygota horsfieldii*	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
obah	*Eugenia* spp.	1	6	7	8	8	9	10	10	11	12	12	13	14	15	15	16	17	17	18	19
obeche	*Triplochiton scleroxylon*	4	-	7	8	9	10	10	11	12	13	14	15	15	16	16	17	18	18	19	20
odoko	*Scottellia coriacea*	4	-	8	9	10	11	12	13	14	14	15	16	16	17	18	18	19	20	21	21
olive, East African	*Olea hochstetteri*	4	-	9	10	11	12	13	14	15	15	16	17	18	18	19	20	21	22	23	24
olivillo	*Aextoxicon punctatum*	4	-	7	8	9	10	10	11	12	13	14	15	15	16	16	17	18	18	19	20

Standard Trade Name	Botanical Name	Source	Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Correct Moisture Content (%)																		
opepe	*Nauclea diderrichii*	4	-	11	12	12	13	14	14	15	16	16	17	17	18	18	19	20	21	22	23
padauk, African	*Pterocarpus soyauxii*	4	-	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	19	20	21
palaquium, Fijian	*Palaquium hornei*	10	7	8	9	9	10	11	11	12	12	13	14	14	15	16	16	17	17	-	-
palaquium, Solomon Is.	*Palaquium* spp.	1	5	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17	18	18	19
papuacedrus	*Papuacedrus papuanus*	1	8	9	10	11	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
parinari, Fijian	*Parinari insularum*	10	6	7	8	9	9	10	11	12	13	14	14	15	16	17	18	19	20	20	21
penarahan (Malaysia)	*Myristica iners*	12	*8*	*9*	*10*	*11*	*12*	13	14	15	16	17	18	19	20	21	22	23	-	-	-
peppermint, broad-leaved	*Eucalyptus dives*	1	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
peppermint, narrow-leaved	*E. australiana*	1	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21	22	22	23
perupok (Malaysia)	*Lophopetalum subovatum*	12	10	11	12	13	14	15	16	17	18	19	20	21	23	24	24	25	26	28	-
perupok (Malaysia)	*Kokoona* spp.	12	*4*	*5*	*7*	*8*	10	11	12	14	16	17	19	21	22	23	24	26	28	30	-
persimmon, grey	*Diospyros pentamera*	1	8	8	9	10	10	11	11	12	13	13	14	14	15	16	16	17	18	18	19
persimmon (U.S.A.)	*D. virginiana*	4	-	7	8	9	10	10	11	12	13	14	15	15	16	16	17	18	18	19	20
pillarwood	*Cassipourea malosano*	4	-	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	19	20	21
pine, Aleppo	*Pinus halepensis*	1	9	10	11	11	12	13	14	14	15	16	17	18	18	19	20	21	22	22	23
pine, Benguet	*P. insularis*	3	-	11	13	14	15	16	17	18	19	20	21	22	24	25	26	27	28	29	30
pine, black	*Prumnopitys amara*	1	6	7	8	9	10	11	12	12	13	14	15	16	16	17	18	19	19	20	21
pine, bunya	*Araucaria bidwillii*	1	9	10	11	12	12	13	14	14	15	16	16	17	18	18	19	20	21	21	22
pine, Canary Is.	Pinus canariensis	1	8	8	9	10	11	12	13	14	14	15	16	17	18	19	19	20	21	22	23
pine, Caribbean	*P. caribaea*	4	-	9	10	11	12	13	14	15	-	-	-	-	-	-	-	-	-	-	-

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
pine, Caribbean (immature)(Fiji)	*P. caribaea*	10	5	7	8	10	11	12	14	15	17	18	20	21	22	24	25	-	-	-	-
pine, celery-top	*Phyllocladus asplenifolius*	1	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19	19	20	21	21
pine, Corsican (N.Z.)	*Pinus nigra*	9	-	-	10	11	12	13	14	15	16	18	19	20	21	22	24	25	26	27	28
pine, cypress, northern	*Callitris columellaris*	1	7	8	9	10	11	12	12	13	14	15	16	17	17	18	19	20	21	21	22
pine, cypress, Rottnest Is.	*C. preissii*	1	9	10	11	11	12	13	14	15	16	16	17	18	19	20	21	21	22	23	24
pine, cypress, white	*Callitris columellaris*	1	8	9	10	10	11	12	13	14	15	16	17	18	19	20	21	22	22	23	24
pine, hoop	*Araucaria cunninghamii*	1	9	10	11	12	12	13	14	15	16	16	17	18	19	20	21	22	22	23	24
pine, Huon	*Dacrydium franklinii*	1	9	10	10	11	12	13	13	14	15	15	16	17	18	18	19	20	20	21	22
pine, jack	*Pinus banksiana*	7	-	-	6	7	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
pine, kauri, Queensland	*Agathis robusta*	1	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24	24	25
pine, King William	*Athrotaxis selaginoides*	1	9	9	10	11	12	12	13	14	14	15	16	16	17	18	18	19	20	20	21
pine, klinki	*Araucaria hunsteinii*	1	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
pine, loblolly (Qld)	*Pinus taeda*	1	8	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
pine, loblolly (immature)	*P. taeda*	1	5	6	8	9	11	12	14	15	17	18	19	20	22	23	24	-	-	-	-
pine, lodgepole	*P. contorta*	2	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
pine, longleaf	*P. palustris*	4	-	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27
pine, maritime	*P. pinaster*	1	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20	21	21	22	23
pine, New Zealand white	*Dacrycarpus dacrydioides*	5	-	-	-	-	11	12	12	13	14	15	16	16	17	18	19	19	20	21	22
pine, Parana	*Araucaria angustifolia*	1	6	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23

Standard Trade Name	Botanical Name	Source	Meter Reading (Moisture Content %) 6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			Correct Moisture Content (%)																		
pine, ponderosa	*Pinus ponderosa*	2	-	7	9	10	11	13	14	15	16	17	18	19	20	21	22	22	23	24	25
pine, radiata (N.Z.)	*P. radiata* (immature)	1	6	7	8	10	11	12	13	14	16	17	18	19	20	22	23	24	25	27	28
pine, radiata (S.A.)	*P. radiata*	1	9	10	11	11	12	13	14	15	16	17	18	19	20	21	22	24	25	26	27
pine, radiata (Vic.)	*P. radiata*	1	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
pine, red	*P. resinosa*	7	-	-	-	7	8	9	11	12	13	14	15	16	17	18	19	20	22	23	24
pine, shortleaf	*P. echinata*	4	-	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27
pine, slash (Qld)	*P. elliottii*	1	7	8	9	10	11	12	13	14	15	16	17	17	18	19	20	21	22	23	24
pine, slash (immature)	*P. elliottii*	1	6	7	8	9	10	11	12	14	15	17	18	20	21	22	24	-	-	-	-
pine, stone	*P. pinea*	1	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24	25
pine, sugar (imported)	*Pinus lambertiana*	1	7	8	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24	25	26
pine, western white	*P. monticola*	2	-	-	8	9	10	11	11	12	13	14	15	16	17	17	18	19	20	21	22
pittosporum (Tas.)	*Pittosporum bicolor*	1	5	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	20	21
planchonella, Fijian	*Planchonella vitiensis*	10	7	7	8	9	9	10	11	11	12	13	13	14	14	15	16	16	17	18	18
planchonella, New Guinea	*P. kaernbachiana*	1	6	6	7	8	9	9	10	11	12	12	13	14	15	16	16	17	18	19	19
planchonella, New Guinea	*P. torricellensis*	1	4	5	6	6	7	8	8	9	10	11	11	12	13	13	-	-	-	-	-
planchonella, Solomon Is.	*P. thyrsoidea*	1	5	5	6	7	7	8	8	9	10	10	11	11	12	13	-	-	-	-	-
planchonia	*Planchonia papuana*	1	7	8	8	9	10	11	12	12	13	14	15	15	16	17	18	19	19	20	21
pleiogynium	*Pleiogynium timorense*	1	8	8	9	9	10	11	11	12	12	13	13	14	15	15	16	16	17	18	18
podocarp, Fijian	*Podocarpus neriifolius*	10	8	9	9	10	11	12	13	14	14	15	16	17	18	19	20	20	21	22	23
podocarp, red (Fijian)	*Dacrycarpus imbricatus*	10	7	8	9	9	10	11	11	12	13	14	14	15	16	16	17	18	18	19	20
podocarp, red	*Decussocarpus vitiensis*	1	8	9	10	11	12	13	13	14	15	16	17	18	19	20	20	21	22	23	24
poplar, black	*Populus nigra*	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
poplar, pink	*Euroschinus falcata*	1	8	8	9	10	10	11	12	12	13	14	14	15	16	17	17	18	19	19	20

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
quandong, brown	*Elaeocarpus coorangooloo*	11	8	8	8	9	9	10	11	11	12	13	14	14	15	16	17	19	20	21	22
quandong, silver	*E. grandis*	1	7	7	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19
quandong, Solomon Is.	*E. sphaericus*	1	5	6	6	7	8	9	9	10	11	11	12	13	14	14	15	16	17	17	18
qumu	*Acacia richii*	10	7	7	8	9	9	10	11	12	12	13	14	14	15	16	17	17	18	19	19
raintree (Fiji)	*Samanea saman*	10	6	6	7	7	8	8	9	9	10	10	11	11	12	-	-	-	-	-	-
ramin, Fijian	*Gonystylus punctatus*	10	7	8	9	10	10	11	12	12	13	14	15	15	16	17	17	18	19	20	20
ramin, Philippine	*G. macrophyllus*	3	-	11	12	12	13	14	15	15	16	17	18	18	19	20	21	21	22	23	24
ramin, Malaysian	*G. bancanus*	12	*9*	*10*	*11*	*12*	13	14	15	16	17	18	19	20	21	22	23	25	27	28	30
ramin, Sarawak	*Gonystylus* spp.	1	6	7	8	9	10	10	11	12	13	14	15	15	16	17	18	19	20	20	21
redwood	*Sequoia sempervirens*	1	8	9	10	10	11	12	13	14	15	16	16	17	18	19	20	20	21	22	23
rengas (Malaysia)	*Gluta* spp.	12	*6*	*7*	*8*	*9*	*10*	*11*	12	13	14	14	15	16	17	18	19	20	21	22	23
resak (Malaysia)	*Cotylelobium melanoxylon*	12	5	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	14	15	16	17	18	20	21	22	23	23
roble pellin	*Nothofagus obliqua*	4	-	8	9	10	11	12	13	14	14	15	16	16	17	18	18	19	20	21	21
rosarosa	*Heritiera ornithocephala*	10	8	8	9	10	10	11	12	13	13	14	15	15	16	17	18	18	19	-	-
rosewood, New Guinea	*Pterocarpus indicus*	1	6	7	8	8	9	10	10	11	12	13	13	14	15	15	16	17	17	18	19
rosewood, Philippine	*P. indicus*	3	-	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18	19	19	20
rosewood, Indian	*Dalbergia* spp.	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
sapele	*Entandrophragma cylindricum*	4	-	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27
sasauira (Fiji)	*Dysoxylum quercifolium)* *D. richii)*	10	6	7	7	8	9	10	10	11	12	13	13	14	15	-	-	-	-	-	-
sassafras	*Doryphora sassafras)* *Daphnandra micrantha*	1	8	8	9	10	10	11	12	13	13	14	15	16	16	17	18	18	19	20	21
sassafras, southern	*Atherosperma moschatum*	1	9	9	10	11	11	12	13	13	14	15	15	16	17	17	18	19	19	20	21

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
satinash, blush	*Eugenia hemilampra*	1	5	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	22
satinash, grey	*E. gustavioides*	1	7	8	9	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23
satinash, New Guinea	*Syzygium buettneranum*	1	6	7	8	8	9	10	11	11	12	13	13	14	15	16	16	17	18	19	19
satinash, rose	*Eugenia francisii*	1	6	7	7	8	8	9	10	10	11	12	12	13	13	14	15	15	16	-	-
satinay	*Syncarpia hillii*	1	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
satinbox	*Phebalium squameum*	1	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
satinheart, green	*Geijera salicifolia*	1	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	-	-
satinwood, tulip	*Rhodosphaera rhodanthema*	1	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
scentbark	*Eucalyptus aromaphloia*	1	6	7	8	9	9	10	11	12	13	14	15	16	16	17	17	18	18	18	19
schizomeria, New Guinea	*Schizomeria serrata*	1	7	8	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	22
schizomeria, Solomon Is.	*Schizomeria serrata*	1	5	6	6	7	8	8	9	9	10	11	11	12	13	13	14	15	-	-	-
sepetir (Malaysia)	*Sindora coriaceae*	12	*3*	*4*	*5*	*6*	7	*8*	*9*	*10*	*11*	12	13	14	15	16	17	18	19	20	21
she-oak, Fijian beach	*Casuarina nodiflora*	10	7	8	9	10	10	11	12	13	13	14	15	16	16	17	18	18	19	20	21
sheoak, river	*C. cunninghamiana*	1	8	8	9	10	10	11	11	12	12	13	14	14	15	16	16	17	17	18	19
sheoak, rose	*C. torulosa*	1	9	9	10	11	11	12	13	13	14	14	15	15	16	16	17	18	18	19	19
sheoak, Western Australian	*Casuarina fraserana*	1	9	9	10	11	11	12	12	13	14	14	15	16	16	17	18	18	19	20	20
silkwood, bolly	*Cryptocarya oblata*	1	9	9	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18
silkwood, red	*Palaquium galactoxylum*	1	5	6	7	7	8	9	10	10	11	12	12	13	14	14	15	16	17	17	18
silkwood, silver	*Flindersia acuminata*	1	9	9	10	11	12	12	13	14	15	15	16	17	18	18	19	20	20	21	22
simpoh (Philippines)	*Dillenia philippinensis*	3	-	8	9	10	11	12	13	14	15	16	17	18	18	19	20	21	22	23	24

			Meter Reading (Moisture Content %)																		
			6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Standard Trade Name	**Botanical Name**	**Source**	Correct Moisture Content (%)																		
siris, white	*Ailanthus peekelii*	1	6	7	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19	20	21
siris, white	*A. triphysa*	1	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19	19	20	21	22
sloanea	*Sloanea* spp.	1	7	7	8	9	10	11	12	12	13	14	15	16	17	17	18	19	20	21	21
spondias	*Spondias dulcis*	1	6	7	7	8	9	10	10	11	12	13	13	14	15	16	17	17	18	19	20
spruce, black	*Picea mariana*	7	-	-	-	7	8	9	10	12	13	14	15	16	17	17	18	19	20	21	23
spruce (Canada)	*Picea* spp.	1	7	8	9	9	10	11	12	12	13	14	14	15	16	16	17	18	19	19	20
spruce, Sitka (U.S.A.)	*P. sitchensis*	2	-	7	8	9	10	11	12	13	15	16	17	18	19	20	21	22	23	24	25
spruce, Sitka (Vic.)	*P. sitchensis*	1	-	8	9	10	11	12	14	15	16	17	18	19	20	21	22	-	-	-	-
spruce, white	*P. glauca*	2	7	9	10	11	12	13	14	15	16	17	18	20	21	22	23	24	25	26	27
sterculia, Fijian	*Sterculia vitiensis*	10	6	7	7	8	9	9	10	10	11	12	12	13	14	14	15	15	16	17	-
sterculia, New Guinea	*S. conwentzii*	1	6	6	7	8	8	9	10	10	11	11	12	13	13	14	15	15	16	17	-
sterculia	*Sterculia* spp.	4	-	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
stringybark, brown	*Eucalyptus capitellata*	1	8	9	10	11	11	12	13	14	15	16	17	18	19	19	20	21	22	23	24
stringybark, Darwin	*E. tetrodonta*	1	7	8	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	22
stringybark, yellow	*E. muellerana*	1	10	11	12	13	14	14	15	16	17	18	18	19	20	21	21	22	23	24	24
sycamore	*Acer pseudoplatanus*	4	-	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	19	20	21
sycamore, satin	*Ceratopetalum succirubrum*	1	8	9	9	10	11	11	12	12	13	14	14	15	16	16	17	18	18	19	20
sycamore, silver	*Cryptocarya glaucescens*	1	9	9	10	10	11	12	12	13	13	14	14	15	16	16	17	17	18	19	19
tallowwood	*Eucalyptus microcorys*	1	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
taun (Malaysia)	*Pometia pinnata*	12	-	-	*4*	*5*	*6*	*8*	9	9	11	13	14	15	16	17	19	20	21	22	23
taun (N.G.)	*Pometia pinnata*	1	8	9	10	11	12	13	15	16	17	18	19	20	22	23	24	25	26	26	27
taun (Philippines)	*P. pinnata*	3	-	10	11	12	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
taun (Solomon Is.)	*P. pinnata*	1	6	7	7	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19	19
tawa	*Beilschmiedia tawa*	1	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18

			Meter Reading (Moisture Content %)																		
			6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Standard Trade Name	Botanical Name	Source	Correct Moisture Content (%)																		
teak	*Tectona grandis*	4	-	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	19	20	21
terap (Malaysia)	*Artocarpus elasticus*	12	-	-	-	-	15	16	17	19	21	25	27	28	30	-	-	-	-	-	-
terminalia, brown (N.G.)	*Terminalia brassii*	1	6	7	7	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22
terminalia, brown (Solomon Is.)	*T. brassii*	1	5	6	7	7	8	9	9	10	11	12	12	13	14	15	15	16	17	17	18
terminalia, red brown (Philippines)	*T. microcarpa*	3	-	5	6	7	8	8	9	10	11	11	12	13	14	15	15	16	17	18	18
terminalia, yellow (New Guinea)	*T. complanata*	1	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	20	21	22
terminalia, yellow (Solomon Is.)	*T. calamansanai*	1	5	6	7	7	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19
tetrameles	*Tetrameles nudiflora*	1	6	7	8	8	9	10	11	11	12	13	14	14	15	16	17	17	18	19	20
tingle, red	*Eucalyptus jacksonii*	1	7	9	10	11	12	13	15	16	17	18	19	21	22	23	24	25	27	28	29
tingle, yellow	*E. guilfoylei*	1	7	9	10	11	12	13	14	15	17	18	19	20	21	22	23	25	26	27	28
totara	*Podocarpus totara*	1	8	8	9	10	10	11	12	12	13	14	14	15	16	16	17	18	18	19	19
touriga, red	*Calophyllum costatum*	1	10	11	11	12	13	14	14	15	16	17	17	18	19	20	20	21	22	23	23
tristiropsis, New Guinea	*Tristiropsis canarioides*	1	8	8	9	10	11	11	12	13	14	14	15	16	16	17	18	19	19	20	21
tuart	*Eucalyptus gomphocephala*	1	9	9	10	11	12	12	13	14	15	15	16	17	17	18	19	20	20	21	22
tulipwood	*Harpullia pendula*	1	9	9	10	11	12	12	13	14	15	16	16	17	18	19	20	20	21	22	23
turpentine	*Syncarpia glomulifera*	1	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24
vaivai-ni-veikau	*Serianthes melanes1ca*	10	6	7	7	8	9	9	10	11	11	12	12	13	14	14	15	16	16	17	18
vatica, Philippine	*Vatica manggachapoi*	3	-	9	10	10	11	12	12	13	14	14	15	15	16	17	17	18	19	19	20
vitex, New Guinea	*Vitex cofassus*	1	7	8	8	9	10	11	12	13	13	14	15	16	17	18	18	19	20	21	22
vuga	*Metrosideros collina*	10	7	8	8	9	9	10	10	11	12	12	13	13	14	14	15	16	16	-	-
vutu	*Barringtonia edulis*	10	5	6	7	7	8	8	9	9	10	11	11	12	12	13	-	-	-	-	-
walnut (West Africa)	*Lovoa trichilioides*	4	-	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27

			Meter Reading (Moisture Content %)																		
			6	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Standard Trade Name	**Botanical Name**	**Source**	**Correct Moisture Content (%)**																		
walnut, blush	*Beilschmiedia obtusifolia*	1	9	10	11	11	12	12	13	14	14	15	16	16	17	18	18	19	19	20	21
walnut, European	*Juglans regia*	4	-	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27
walnut, New Guinea	*Dracontomelum* spp.	1	6	7	8	9	10	11	12	13	14	15	16	17	17	18	19	20	-	-	-
walnut, New Guinea (Philippines)	*D. dao*	3	-	7	8	8	9	10	10	11	12	12	13	14	15	15	16	17	17	18	19
walnut, Queensland	*Endiandra palmerstonii*	1	7	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27
walnut, rose	*E. muelleri*	1	4	5	6	7	8	9	10	10	11	12	13	14	15	16	16	17	18	19	20
walnut, white	*Cryptocarya obovata*	1	8	9	9	10	11	11	12	13	13	14	14	15	16	16	17	18	18	19	20
walnut, yellow	*Beilschmiedia bancroftii*	1	6	7	8	8	9	10	10	11	12	12	13	14	14	15	16	17	17	18	19
wandoo	*Eucalyptus wandoo*	1	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	23	24	25	25
wattle, hickory	*Acacia penninervis*	1	8	8	9	10	11	11	12	13	13	14	14	15	16	16	17	18	18	19	20
wattle, silver	*A. dealbata*	1	8	9	10	10	11	12	13	13	14	15	16	16	17	18	19	20	20	21	22
woolybutt	*Eucalyptus longifolia*	1	9	10	10	11	12	13	14	15	15	16	17	18	19	20	20	21	22	23	24
yaka	*Dacrydium nausoriensis)* *D. nidulum)*	10	8	9	9	10	11	12	12	13	14	14	15	16	17	17	18	19	19	20	21
yasi-yasi I (Fiji)	*Syzygium effusum)* *S. nidie)*	10	6	6	7	8	9	10	11	11	12	13	14	15	15	16	17	17	18	19	19
yasi-yasi II (Fiji)	*Cleistocalyx* spp.) *Syzygium* spp.)	10	6	7	8	9	10	11	12	13	14	14	15	16	17	18	19	20	21	21	22
yate	*Eucalyptus cornuta*	1	8	9	10	10	11	12	12	13	14	15	16	16	17	18	19	19	20	21	22
yertchuk	*E. consideniana*	1	9	10	11	12	13	14	15	16	17	18	19	20	20	21	22	23	24	25	26

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APPENDIX 2

TEMPERATURE CORRECTIONS FOR ELECTRIC RESISTANCE METERS.

For electic resistance meters with a calibration wood temperature of 20° to 21°C

Temperature of wood	Meter Reading																						
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Meter reading corrected for temperature																						
5 °C	7	8	9	11	12	13	14	15	16	17	19	20	21	22	-	-	-	-	-	-	-	-	-
10 °C	7	8	9	10	11	12	13	14	16	17	18	19	20	21	22	-	-	-	-	-	-	-	-
15 °C	6	7	8	9	11	12	13	14	15	16	17	18	19	20	22	-	-	-	-	-	-	-	-
20 °C	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	-	-	-	-	-	-
25 °C	-	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	-	-	-	-	-
30 °C	-	6	7	8	9	10	11	12	12	13	14	15	16	17	18	19	20	21	22	-	-	-	-
35 °C	-	-	6	7	8	9	10	11	12	13	14	15	15	16	17	18	19	20	21	22	-	-	-
40 °C	-	-	-	6	7	8	9	10	11	12	13	14	15	16	16	17	18	19	20	21	22	-	-
50 °C	-	-	-	-	6	7	8	9	10	11	11	12	13	14	15	16	17	18	19	19	20	21	22
60 °C	-	-	-	-	-	6	7	8	8	9	10	11	12	13	14	14	15	16	17	18	19	20	20
70 °C	-	-	-	-	-	-	-	6	7	8	9	10	11	11	12	13	14	15	16	16	17	18	19
80 °C	-	-	-	-	-	-	-	-	6	7	8	9	9	10	11	12	13	13	14	15	16	17	18
90 °C	-	-	-	-	-	-	-	-	-	6	7	8	8	9	10	11	11	12	13	14	15	15	16

Based on data in: Keylwerth, R. and Noak, D. ["The effect of elevated temperatures on the measurement of the moisture content of wood by the electric-resistance method".] *Holz als Roh-und Werkstoff*, 14(5), May 1956: 162-172.

Temperature corrections are usually applied before corrections for species.

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