

OPERATING MANUAL

GMK 100

Material Moisture Measuring Device

For non-destructive capacitive measurements



H68.0.01.6C-08



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1 General Note

Read this document carefully and get used to the operation of the device before you use it. Keep this document within easy reach near the device for consulting in case of doubt.

2 Safety

2.1 Intended Use

The device is designed for measurements of moisture (%u) and water content (%w) of materials with a flat surface and a thickness of at least 10mm.

The measurement takes place at an insulated measuring spot at the rear side of the device.

The GMK 100 is particularly suited for moisture measurements in the following materials:

- wood
- concrete and floor screed
- plaster
- etc.

The device must be used only according to its intended purpose and under suitable conditions.

Personnel which starts up, operates and maintains the device has to have sufficient knowledge of the measuring procedure and the meaning of the resulting measured values, this manual delivers a valuable help for this. The instructions of the manual must be understood, regarded and followed.

To be sure that there is no risk arising due to misinterpretation of measured values, the operator must have further knowledge in case of doubt - the user is liable for any harm/damage resulting from misinterpretation due to insufficient knowledge.

The manufacturer will assume no liability or warranty in case of usage for purposes other than the intended one, ignoring this manual, operating by unqualified staff as well as unauthorized modifications to the device.

Use the device carefully and according to its technical data (do not throw it, strike it, ...) Protect the device from dirt.

2.2 Safety signs and symbols

Warnings in this document are labeled with the following signs:



Caution! This symbol warns of imminent danger, death, serious injuries and significant damage to property at non-observance.



Attention! This symbol warns of possible dangers or dangerous situations which can provoke damage to the device or environment at non-observance.



Note! This symbol points out processes which can indirectly influence operation, possibly cause incorrect measurement or provoke unforeseen reactions at non-observance.

2.3 Reasonably foreseeable misuse



To prevent malfunction of the device, personal injury and material damage, the device is designed exclusively for use as described in the chapter "Intended Use".

- This device must not be used at potentially explosive areas!
- The device must not be used at a patient for diagnosis or any other medical purpose!
- Do not use these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury or material damage.


Any failure to comply with these instructions could result in death, serious injury and material damage.

The measuring principle implies that both water and metal are influencing the display value. Eventually existing metal structures may have negative effect to the measuring, please consider the Measurement Basics (please refer to chapter 6).

2.4 Safety guidelines

This device has been designed and tested in accordance with the safety regulations for electronic devices. However, its trouble-free operation and reliability cannot be guaranteed unless the standard safety measures and special safety advice given in this manual will be adhered to when using the device.

1. Trouble-free operation and reliability of the device can only be guaranteed if the device is not subjected to any climatic conditions other than those stated under "Specifications". If the device is transported from a cold to a warm environment condensation may cause a failure of the function. In such a case make sure the device temperature has adjusted to the ambient temperature before trying a new start-up.

2.  If there is any risk involved in running it, the device has to be switched off immediately and must be marked accordingly to avoid re-starting. Operator safety may be a risk if:
 - there is visible damage to the device
 - the device is not working as specified
 - the device has been stored under unsuitable conditions for a longer time.In case of doubt, please return device to manufacturer for repair or maintenance.

3 Product Description

3.1 Scope of supply

The scope of supply includes:

- GMK 100
- 9V - battery
- Operating manual
- Short manual

3.2 Operation and maintenance advice

Battery powered supply:

If 'bAt' is shown in the lower display the battery has been used up and needs to be replaced. However, the device will operate correctly for a certain time.



The battery must be taken out when storing the device above 50°C. We recommend taking out the battery if the device is not used for a longer period of time.

4 Display and Control Elements

4.1 Display elements



1: Main display	Display of the current moisture or water content
2: Material display	The name of the selected material characteristic curve is displayed
3: Moisture rating	Moisture rating via bar graph
4: HLD	The measuring value is "frozen" (hold-key)

4.2 Control elements

Key 1:	on/off key Press long: switch device off Press briefly: activation of backlight see chapter 13, "Li"
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Key 2:	mode up Material selection: upwards, see chapter 6.46.4
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Key 3:	hold down press briefly: The currently measured value is "frozen" (hold-function), "HLD" is displayed press for 2 sec.: Zeroing function (see chapter 6.5)
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Keys 2 & 3 together:	sort down Material selection: downwards, see chapter 6.4
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Depth switch: (on the right side)	Sliding switch up: ca. 10 mm measuring depth (d 10) Sliding switch down: ca. 25 mm measuring depth (d 25) After changing the measuring depth "d 10" (for 10mm) or "d 25" (for 25 mm) is briefly displayed.
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4.3 Measuring spot: rear side





Rear side of the device:

The entire light grey surface must lie on the measured material without any air gaps.

The areas marked “10 mm” (dark gray) and “25 mm” (white) indicate the areas under which measurements are primarily taken, depending on the position of the slide switch.

5 Start of operation

Switch the device on with the  key.

After the segment test  the device displays some information about its configuration:

- 5. *i0* If there is a slope adjustment for the 10 mm measurement (see chapter 14)
- 5.25 If there is a slope adjustment for the 25 mm measurement (see chapter 14)
- P.oF If the automatic-off-function is activated (see chapter 13)

The device is ready for measuring afterwards.

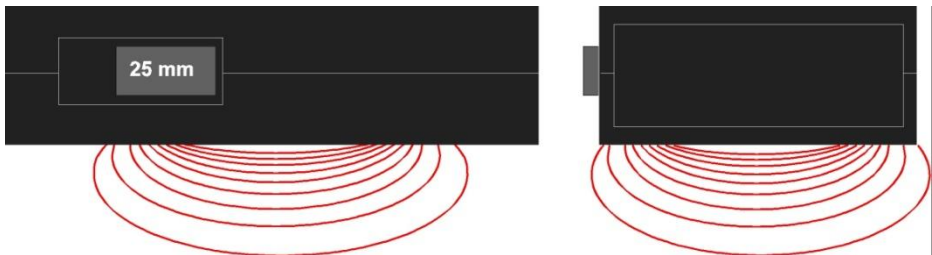
6 Measurement Basics

6.1 Measuring field & depth

The device measures by means of an electric field (capacitive measuring method), which propagates from the rear side downwards. The measuring depth can be changed between approx. 10 mm and 25 mm with the sliding switch.



Side view: measuring field and penetration depth for switch setting "10 mm"



Side view: measuring field and penetration depth for switch setting "25 mm"

The specifications for the penetration depth 10 mm and 25 mm are just approximate values. The actual depth will be higher the wetter the measured material is. Therefore, areas deeper than 25 mm will be measured in very wet materials and for switch setting 25 mm.

Lower values will be displayed when measuring thinner materials (e.g. plywood).

The area under which the measurement is predominantly taking place is marked on the rear side.



For precise measurements not only the marked measuring spots but the device's entire rear side must lie flat on the measured material. If there is an air gap between the device and the material the measured value will be too dry!

Some examples for measurements that are not precise (measured value too dry in all cases):



*False: wrinkled surface
(extreme example!)*



*False: unsteady
surface*



False: material too thin

6.2 Moisture rating ('WET' - 'MEDIUM' - 'DRY')

In addition to the measuring value there is a moisture rating via a bar graph and an acoustic signal (if activated (see chapter 13): Therefore the determination 'wet or dry' is easy and comfortable for most applications and no longer has to be deduced from literature and tables.



However, this rating can only be a first approximate value, because factors like the application field of the measured material must be considered for the final rating. This device cannot completely replace the knowledge of an experienced craftsman or technical expert.

6.3 Holding the device



The water content of the hand has an impact on the measuring value, if the device is held inappropriately.

The best results will be obtained if you lay the device down or hold it the way as shown in picture 3.



*Picture 1: Held in a **wrong**
way!*



*Picture 2: laid down -
right!*




*Picture 3: Held in the **right**
way!*



6.4 Characteristics and materials


Characteristics		Recommended depth switch setting
rEF	Reference characteristics	
d.45	Wood, density = 450 kg/m ³	
d.50	Wood, density = 500 kg/m ³	
d.55	Wood, density = 550 kg/m ³	
d.60	Wood, density = 600 kg/m ³	
d.65	Wood, density = 650 kg/m ³	
d.70	Wood, density = 700 kg/m ³	
d.75	Wood, density = 750 kg/m ³	
d.80	Wood, density = 800 kg/m ³	
d.85	Wood, density = 850 kg/m ³	
d.90	Wood, density = 900 kg/m ³	
d.95	Wood, density = 950 kg/m ³	
d.99	Wood, density = 1000 kg/m ³	
bEt	Concrete (density ≈ ca. 2.2 to/m ³)	25 mm
E.ZE	Cement screed (density ≈ 2.2 to/m ³)	25 mm
E.ZC	Cement-calcium sulfate-flowing screed	25 mm
E.An	Anhydrite screed	25 mm
P.Gi	Gypsum plaster	10 mm
P.2	Lime cement plaster	10 mm

You can find a list of different types of wood and their corresponding characteristics d.xx in the addendum.

The materials are selected with these keys:

Material selection upwards: press 

Material selection downwards: press   at the same time


 The use of inappropriate characteristics can cause faulty measurements!

6.5 Zeroing function

For the best measuring results, it is recommended to run the zeroing function regularly:

Hold the device in the air as shown in the picture on the right and press the “hold” key for 2 seconds.

You can easily see whether the zero-point is ok with the “rEF” characteristic. If the device shows at air a value <0.5 or >0.5 or “Er.4” with “rEF” characteristic, you must run the zeroing function.

 Please pay attention not to influence the zeroing function with your hands.
The best way to ensure this is shown on the right.



NOTE: The zeroing function adjusts the zero-point for 10 mm and 25 mm simultaneously.

7 Wood Measuring

Choose material corresponding to your type of wood according to the table in addendum A.

Example: You want to measure Scots pine -> select material d.50

Best results are obtained if you measure crossways to the wood's grain. (see right picture)

Unplaned or wrinkled surfaces result in measurements that are too low!

NOTE: Wood is a natural product. Its density fluctuates due to the tree's growth and flaws (knots, cracks, resin pockets, etc.). This may lead to measuring errors up to several %u, because the measurement depends on density.

If your kind of wood is not listed in addendum A, you have to know its density (dry): for example, a wood of density 0.68 kg/dm^3 is measured with material d.70 (approximate actual density to the next material $0.52 \rightarrow \text{d.50}$, $0.53 \rightarrow \text{d.55}$).



8 Plaster Measuring



Rough surfaces will influence the measuring results. Precise values are only obtained at even surface and without any air gaps between surface and device. Metal grids can cause additional measuring faults.

Use measuring depth "10 mm" if you want to rate plaster moisture.

There are a lot of different products for plastering with highly varying densities. This can lead to erroneous measurements, because the measurement significantly depends on density. Please consider the notes of chapter 8 "**Fehler! Ungültiger Eigenverweis auf Textmarke.**" if you rate an unfamiliar plaster.

9 Floor screed Measurement

Use measuring depth "25 mm" for floor screed measurements to rate ideally the whole thickness of the screed.

NOTE: Floor screed dries patchy and therefore areas may be differently wet. A big amount of water has to be released upwards (evaporate) before you can tile it. The floor screed has to be drier if a vapor-tight covering should be used as if it would be with a diffusion permeable covering. Therefore the moisture rating of the device can only be a first approximate value and the decision whether the floor is ready for further covering or not cannot be based only on this rating.



Reinforcements (iron) or floor heating near the surface may cause erroneous measuring results. Please consider chapter 12.2 CM-moisture

10 Plasterboard Measurement

Plasterboard is usually relatively slim (i.e. 12.5mm) -> select measuring depth 10mm.



Screws, cables and constructions behind the plasterboard (supporting stand) may falsify the measurement.

11 Measurement of Other Materials

The device does not have saved characteristics for all materials. Even if there is no characteristic curve for your material you can still perform significant **relative measurements**.

We recommend the material "rEF" (dimensionless digit-value, intentional no %u or %w display) for this purpose.

For example, if you want to evaluate water damage you can measure a surely dry spot and an evidently wet one (identifiable by salt efflorescence, water spots, mould growth, etc.). Then you can compare the other measuring values with them and get the moisture distribution of your measuring area or find the reason for the moisture penetration.

You do not need absolute values (%u or %w) for this.



Please consider that the configuration of the measured wall (cavity block, cement joints, reinforcements, etc.) may also influence the measuring values.

12 Additional Information to Moisture Measurement

12.1 Moisture u and water content w

Either moisture u or water content w is needed according to the application.

Carpenter, joiner, etc. normally use moisture u (relating to oven-dry mass)

Water content w is normally used for combustibles (i.e. wood briquette).

You can choose whether the device should use moisture or water content (see chapter 13)

Moisture u (relating to oven-dry mass)

$$\text{moisture } u[\%] = ((\text{mass}_{\text{wet}} - \text{mass}_{\text{dry}}) / \text{mass}_{\text{dry}}) * 100$$

or:
$$\text{moisture } u[\%] = (\text{mass}_{\text{water}} / \text{mass}_{\text{dry}}) * 100$$

The unit is %u (also common: % atro, weight percent).

mass_{wet} : mass of the sample (= total mass = $\text{mass}_{\text{water}} + \text{mass}_{\text{dry}}$)

$\text{mass}_{\text{water}}$: mass of the water contained in the sample

mass_{dry} : mass of the oven-dried sample after (water has been evaporated)

Example: 1kg wet wood that contains 500g water has a moisture u of 100%.

Water content w (= moisture relating to wet total mass)

$$\text{water content } [\%] = ((\text{mass}_{\text{wet}} - \text{mass}_{\text{dry}}) / \text{mass}_{\text{wet}}) * 100$$

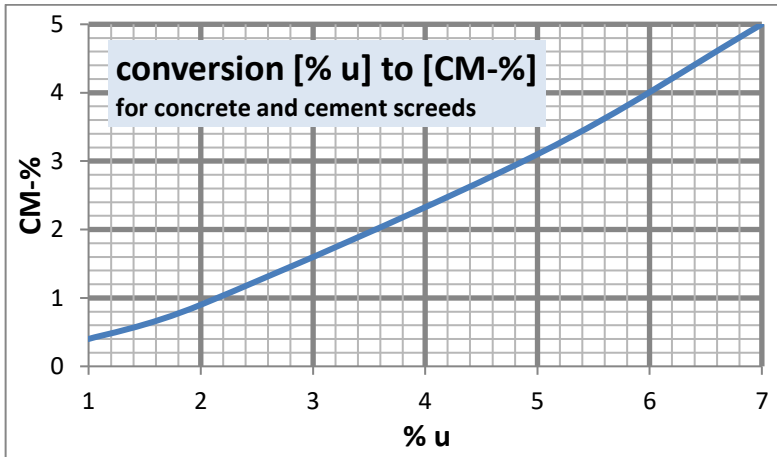
or:
$$\text{water content } [\%] = (\text{mass}_{\text{water}} / \text{mass}_{\text{wet}}) * 100$$

The unit is %w

Example 1kg wet wood that contains 500g water has a water content of 50%.

12.2 CM-Moisture

The CM-moisture (unit [CM%]) is often used for materials like floor screed. This moisture rating is correlated to the moisture u : it is calculated by the same equations. It is measured by the CM-method (destructive testing with high complexity). It is the only accredited measuring method (besides the time-consuming oven-dry method) for floor screed measurements in Germany.








The values measured with CM-method and oven-dry method (%u) may differ for some materials. Especially for building materials containing **cement** CM-measurements will always get lower values than oven-dry measurements. The conversion is material-dependent, because the differences between both values depend on the used product.




The conversion shown in the picture above is a practicable approximation.


For **gypsum**, **gypsum plaster** and **anhydrite screed** the value %u equals approximately the CM-value.

13 Configuration of the device

Follow these instructions to configure the functions of the device:

- Switch the device off.
- Press  and keep it pressed, while turning the device on (briefly press ). Release the mode-button not before the first parameter “P.oF” is displayed.
- Set parameter with up  or down .
- Jump to the next parameter by pressing .

Parameter	Value	Information
Button 	Buttons  	
P.oF	Auto Power-Off (turn-off delay) <i>factory setting: 20 min</i>	
	1 ... 120	Auto Power-Off (turn-off delay) in minutes. If no key is pressed for the time adjusted here, the device is automatically switched off (adjustable 1 ... 120 min)
	oF	Auto power-off is deactivated (continuous operation)
Un1	Display unit <i>factory setting: %u</i>	
	%u	Measuring value displayed in moisture %u
	%w	Measuring value displayed in water content %w
L1	Backlight <i>factory setting: 5</i>	
	oF	No backlight
	5 ... 120	Backlight turns automatically off after 5 ... 120s (battery saving)
ton	Acoustic signal <i>factory setting: on</i>	
	oF	No acoustic signal
	on	Acoustic signal for moisture rating
In1	Restore factory settings	
	no	Parameters are not changed to factory settings.
	Go	ATTENTION: All parameters are changed to factory settings.

Press  again to store changed settings, the device restarts (segment test).

NOTE: If no key is pressed for more than 2 minutes, the configuration will be canceled. Any changes made up to that point will not be saved!

14 Adjustment






The accuracy can be checked with the **testing probe PW 25** (optional accessory).


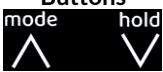
Select the material "rEF" and run the zeroing function (see chapter 6.5).

Lay the device onto the testing cube. If the device displays a value different from the value printed on the cube for the device, you can use the slope correction to adjust the device:

$$\text{Displayed value rEF} = (\text{measured value rEF} * (1 + \text{slope correction} / 100))$$

Follow these instructions to adjust the device:

- Switch the device off.
- Press  and keep it pressed, while turning the device on (briefly press ). Release the hold-button not before the first parameter "5.10" is displayed.
- Set parameter with up  or down .
- Jump to the next parameter by pressing .

Parameter	Value	Information
Button 	Buttons 	
5.10	Slope correction for measuring depth 10 mm <i>factory setting: of= 0%</i>	
	oF / -19 ... +19	Value of slope correction in %
5.25	Slope correction for measuring depth 25 mm <i>factory setting: of= 0%</i>	
	oF / -19 ... +19	Value of slope correction in %


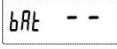
Press  again to store changed settings, the device restarts (segment test).

NOTE: If no key is pressed for more than 2 minutes, the configuration will be canceled. Any changes made up to that point will not be saved!

15 Accuracy Inspection: Adjustment /Update Service

You can send the device to the manufacturer or retailer for adjustment and inspection. Moreover, the manufacturer can do the latest software update. This ensures that future improvements are provided to owners of older devices in a cost-saving way. You can display the current software version if you do not release the on/off button after you switched the device on, but hold it for more than 5 seconds. (i.e. "r. 1.0")

16 Error and System Messages

Er. 1	Value exceeding measuring range, value too high
Er. 4	Value below display range, (value < 19)
Er. 7	System error – the device has detected a system error (device defective or not within working temperature)
	The blinking bAt display indicates low battery voltage, device will continue to work for a short time.
	The battery is consumed and must be changed. Measurements are no longer possible.

17 Disposal

Separation by material and recycling of device components and packaging must take place at the time of disposal. The valid regional statutory regulations and directives applicable at the time must be observed.

! NOTE



The device must not be disposed of with household waste. Return it to us, freight prepaid. We will then arrange for the proper and environmentally friendly disposal.

Private end users in Germany have the possibility of dropping off the device at the municipal collection center. Batteries must be removed beforehand!

Please dispose of empty batteries at the collection points intended for this purpose.

18 Technical Data

Measurement	
Method	Capacitive (=dielectric) measuring method, non-destructive
Depth	2 selectable: approx. 10 mm and approx. 25 mm
Materials	18 characteristic curves for wood and popular materials, additionally reference curve (rEF) for high-resolution relative measurements
Resolution	0.1 %; for more than 19.9 %: 1 % (for both %u and %w)
Range	Water content (w): 0.0 ... 50% (wood) Material moisture (u): 0.0 ... 100% (wood), 0.0...~8.0 (concrete etc.)
Moisture rating	Display: Rating of the moisture in 6 levels from WET to DRY Acoustic: Signal tone, depending on moisture rating
Accuracy	The achievable accuracy depends significantly on the application and the properties of the measured material!
Display	2 displays for material and measured value, backlight
Hold function	Press button to freeze current value.
Working temperature	-5 to 50 °C; 0 to 80 % RH (non-condensing)
Storage temperature	-25 to 70 °C
Power supply	9 V-battery type IEC 6F22 (included)
Power consumption (measurement)	Approx. 0.12 mA (battery life: more than 2500 hours for alkaline battery)
Power consumption (backlight)	Approx. 2.5 mA (Backlight reduces battery life! Automatic turn off function is selectable)
Used battery display	"bAt" displayed if battery used, warning: "bAt" blinking
Auto off-function	Device will be automatically switched off if not operated for longer time (adjustable from 1...120min)
Housing	impact-resistant ABS plastic housing, front side IP65
Dimension	Approx. 106 x 67 x 30 mm (H x W x D)
Weight	Approx. 145 g incl. battery
Directives and standards	The instruments confirm to following European Directives: 2014/30/EU EMC Directive 2011/65/EU RoHS Applied harmonized standards: EN 61326-1:2013 emissions level: class B emi immunity according to A.1 Additional fault: <1% EN IEC 63000:2018

Addendum A: Wood types table

english	lat.	charact.
Abachi	<i>Triplochiton scleroxylon</i>	d.45
Afzelia	<i>Afzelia</i> spp.	d.75
Ash, American-	<i>Fraxinus americana</i>	d.65
Ash, European-	<i>Fraxinus excelsior</i>	d.65
Ash, Manchurian-	<i>Fraxinus mandshurica</i>	d.60
Balau, Bangkirai-	<i>Shorea laevis</i>	d.90
Balau, Red-	<i>Shorea guiso</i>	d.85
Beech, European-	<i>Fagus sylvatica</i>	d.65
Bintangor	<i>Calophyllum kajewskii</i>	d.65
Birch, White-	<i>Betula pubescens</i>	d.60
Birch, Yellow-	<i>Betula lutea</i>	d.65
Bossè	<i>Guarea cedrata</i>	d.55
Bubinga	<i>Guibourtia demeusii</i>	d.85
Cedar, White	<i>Melia azedarach</i>	d.55
Cherry, Black-	<i>Prunus serotina</i>	d.60
Cherry, Wild-	<i>Prunus avium</i>	d.55
Cypressus	<i>Cupressus</i> spp.	d.45
Douglas-fir, Common-	<i>Pseudotsuga menziesii</i>	d.50
Douka	<i>Thieghemella africana</i>	d.65
Ebony	<i>Diospyros</i> spp.	d.99
Elm	<i>Ulmus amer./Ulmus</i> spp.	d.60
Fir, European Silver-	<i>Abies alba</i>	d.45
Fir, Grand-	<i>Abies grandis</i>	d.45
Fir, Pacific Silver-	<i>Abies amabilis</i>	d.45
Fir, Red-	<i>Abies magnifica</i>	d.45
Gum, Sweet	<i>Liquidambar styraciflua</i>	d.50
Hemlock	<i>Tsuga heterophylla</i>	d.45
Hickory	<i>Carya</i> spp.	d.75
Iroko	<i>Chlorophora excelsa</i>	d.65
Jarrah	<i>Eucalyptus marginata</i>	d.75
Jelutong	<i>Dyera costulata</i>	d.45
Jequituba	<i>Cariniana</i> spp.	d.70
Kapur	<i>Dryobalanops</i> spp.	d.60
Karri	<i>Eucalyptus diversicolor</i>	d.85
Larch, European-	<i>Larix decidua</i>	d.55
Larch, Japanese-	<i>Larix kaempferi</i>	d.55
Larch, Western-	<i>Larix occidentalis</i>	d.55
Limba	<i>Terminalia superba</i>	d.50
Linden, American	<i>Tilia americana</i>	d.45
Linden, Common-	<i>Tilia vulgaris</i>	d.50
Locust, Black-	<i>Robinia pseudoacacia</i>	d.70
Magnolia, Cucumber-	<i>Magnolia acuminata/grandiflora</i>	d.50
Mahogany	<i>Swietenia</i> spp.	d.50
Mahogany, African-	<i>Khaya</i> spp.	d.50
Mahogany, Philippine-	<i>Parashorea plicata / Shorea almon</i>	d.50
Maple, New Guinea	<i>Flindersia pimentelianan</i>	d.55
Maple, Sugar-	<i>Acer saccharum</i>	d.70
Maple, Sycamore-	<i>Acer pseudoplatanus</i>	d.55
Mengkulang	<i>Heritiera</i> spp.	d.65
Meranti, Dark Red-	<i>Shorea</i> spp.	d.65
Meranti, White-	<i>Shorea hypochra</i>	d.55
Meranti, Yellow-	<i>Shorea multiflora</i>	d.55

english	lat.	charact.
Merawan	Hopea sulcala	d.70
Merbau	Intsia spp.	d.75
Mersawa	Anisoptera laevis	d.60
Messmate	Eucalyptus obliqua	d.80
Oak, Northern Red-	Quercus spp.	d.65
Oak, Sessile-	Quercus petraea	d.65
Oak, Sawtooth-	Quercus spp.	d.65
Oak, White-	Quercus spp.	d.65
Olive	Olea hochstetteri	d.85
Padouk, African-	Pterocarpus soyauxii	d.70
Paldao	Dracontomelum dao	d.65
Pine, Black-	Podocarpus spicatus	d.50
Pine, European Black-	Pinus nigra	d.55
Pine, Loblolly-	Pinus taeda	d.50
Pine, Lodgepole-	Pinus contorta	d.45
Pine, Longleaf-	Pinus palustris	d.60
Pine, Maritime-	Pinus pinaster	d.50
Pine, Norway-	Pinus resinosa	d.45
Pine, Parana-	Araucaria angustifolia	d.50
Pine, Ponderosa-	Pinus ponderosa	d.45
Pine, Radiata-	Pinus radiata	d.50
Pine, Scots-	Pinus sylvestris	d.50
Pine, Sugar-	Pinus lambertiana	d.45
Poplar, Black-	Populus nigra	d.45
Redcedar, Western-	Thuja plicata	d.45
Rengas	Gluta spp.	d.60
Rimu	Dacrydium cupressinum	d.50
Redwood, California-	Sequoia sempervirens	d.45
Rosewood, Brazilian	Dalbergia latifolia / -nigra	d.85
Rosewood, N. Guinea	Pterocarpus indicus	d.55
Rubber Tree	Hevea Brasiliensis	d.50
Sapele	Entandrophragma cylind.	d.65
Sipo	Entandrophragma utile	d.60
Spruce	Picea abies	d.45
Spruce, Sitka-	Picea sitchensis	d.45
Tiama	Entandrophr. angolense	d.55
Teak	Tectona grandis	d.65
Torem	Manilkara kanosiensis	d.95
Tualang	Koompassia excelsa	d.80
Walnut, Eastern Black-	Juglans nigra	d.60
Walnut, Common-	Juglans regia	d.60
Wenge	Millettia laurentii	d.80

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