

PCE Americas Inc.
711 Commerce Way
Suite 8
Jupiter
FL-33458
USA
From outside US: +1
Tel: (561) 320-9162
Fax: (561) 320-9176
info@pce-americas.com

PCE Instruments UK Ltd.
Units 12/13
Southpoint Business Park
Ensign way
Hampshire / Southampton
United Kingdom, SO31 4RF
From outside UK: +44
Tel: (0) 2380 98703 0
Fax: (0) 2380 98703 9
info@pce-instruments.com

www.pce-instruments.com/english
www.pce-instruments.com

Capacitive moisture measurement device For non-destructive measurement

GMK 100

as of version V1.0

Moisture Analyser



WEEE-Reg.-Nr. DE 93889386

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1 Designated Use

The moisture analyser is designed for measurements of moisture (%u) and water content (%w) of materials with 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.

Applicable for:

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

The safety requirements (see below) have to be observed.

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

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

Protect the device from humidity and dirt.

2 General Note

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

If the device is stored at temperatures above 50°C the battery has to be removed from the device.

NOTE: We recommend taking out battery if device is not used for a longer period of time.
Risk of leakage!

3 Safety Requirements

This moisture analyser 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 advises 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 other climatic conditions than those stated under "Specification".

If the device is transported from a cold to a warm environment condensation may cause in 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. **WARNING:** If there is a risk whatsoever involved in running it, the device has to be switched off immediately and to 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. **WARNING:** 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.



Failure to comply with these instructions could result in death or serious injury and material damage.

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 shortly: activation of backlight p.r.t. chapter 13, „Li“
Key 2:	sort up Material selection: upwards, p.r.t. chapter 6.4
Key 3:	hold: press shortly: The measuring current value is 'frozen' (hold-function), 'HLD' is displayed press for 2sec.: Zeroing function (p.r.t. chapter 6.5)
Key 2 and 3 together:	sort down Material selection: downwards, p.r.t. chapter 6.4



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 device:

The entire light grey surface has to lie on the measured material without any air gap.

The areas "10 mm" (dark grey) and "25 mm" (white) mark the area under that it is predominantly measured.

5 Start of Operation

Switch the device on with the key



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

- 5.10 if there is a slope adjustment for the 10 mm measurement (p.r.t. chapter 14)
- 5.20 if there is a slope adjustment for the 25 mm measurement (p.r.t. chapter 14)
- P.o.F if the automatic-off-function is activated (p.r.t. chapter 13)

The device is ready for measuring afterwards.

6 Measurement Basics

6.1 Measuring field & depth

The device measures with 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 the 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.

On the rear side the area is marked under that it is predominantly measured.

ATTENTION: For precise measurements the device has to lie on the measured material not only at the marked measuring spot but at its whole rear side. If there is an air gap between device and material the measured value will be too dry.



Here are some examples for measurements that are not precise at all. (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 bar graph and acoustic signal (if activated (p.r.t. chapter 13): Therefore the determination 'wet or dry' is easy and comfortable for most applications and has no longer 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 have to be taken into account for the final rating. This device cannot completely replace the knowledge of an experienced craftsman or technical expert.

6.3 Hold 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

Material		Depth switchh	
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

ATTENTION: The use of inappropriate characteristics can cause faulty measurements!



6.5 Zeroing function



It is recommended to run regularly the zeroing function for best measuring results:

Hold the device in the air as shown in the left picture and press key "hold" for 2 seconds.

You can easily see whether the zero point is ok with the "rEF" characteristics. If the device shows at air a value <0.5 or >0.5 or "Er.4" with "rEF" characteristics you have to run the zeroing function.

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



NOTE: There are two different zero points for both measuring depths 10 mm and 25 mm. You have to run the zeroing function for each depth separately.

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 and wrinkled surfaces cause too low measuring results!

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 %, 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

ATTENTION: Rough surfaces will influence the measuring results. Precise values are only obtained at even surface and without any air gap 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 11 "Measurement of Other Materials" 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 vapour-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.

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



10 Plasterboard Measurement

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

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



11 Measurement of Other Materials

The device has not saved characteristics for all materials. But even if there is no characteristic curve for your material you can do 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 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.

NOTE: Please consider that the configuration of the measured wall (cavity block, cement joints, reinforcements, etc.) may also influences 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 (p.r.t. chapter 13).

Moisture *u* (relating to oven-dry mass)

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

or:

$$\text{moisture } u[\%] = (mass_{water} / mass_{dry}) * 100$$

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

mass_{wet}: mass of the sample (= total mass = *mass_{water}* + *mass_{dry}*)

mass_{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)

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

or:

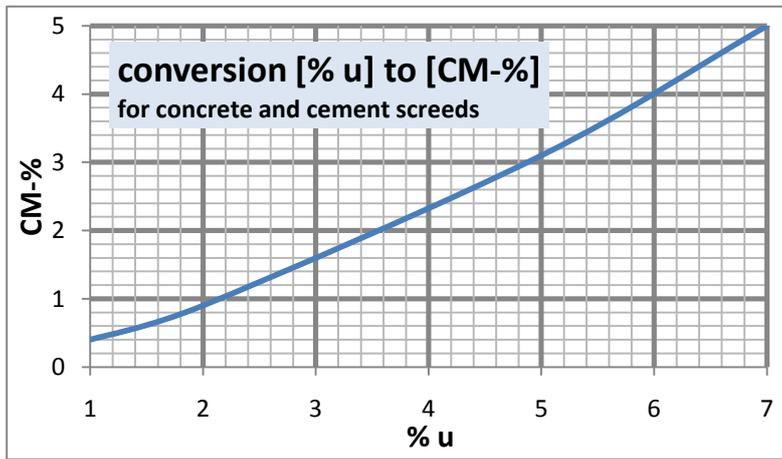
$$\text{water content } [\%] = (mass_{water} / mass_{wet}) * 100$$

The unit is %w

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

12.2 CM-humidity

The CM-humidity (unit [CM%]) is often used for materials like floor screed. This humidity 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 left picture 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 (press  shortly). Release the sort-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
	 	
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)
Uni	Display unit <i>factory setting: %u</i>	
	%u	Measuring value displayed in moisture %u
	%w	Measuring value displayed in water content %w
Li	Backlight <i>factory setting: 5</i>	
	oF	No backlight
	5 ... 120	Backlight turns automatically off after 5 ... 120s (battery saving)
	on	Backlight always on as long as device is switched on
ton	Acoustic signal <i>factory setting: on</i>	
	oF	No acoustic signal
	on	Acoustic signal for moisture rating
ini	Restore factory settings	
	no	Parameters are not changed to factory settings.
	Go	ATTENTION: All parameter are changed to factory settings.

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

NOTE: If there is no key pressed within the menu mode within 2 minutes, the configuration will be cancelled, the entered settings are lost!

14 Adjustment

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

Select the material "rEF" and run the zeroing function (p.r.t. chapter 6.5).

Lay the device onto the testing cube. If the device displays a different value than the value printed on the cube for the GMK 100, 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 (press  shortly). Release the hold-button not before the first parameter "S. 10" is displayed.
- Set parameter with up  or down .
- Jump to the next parameter by pressing .

Parameter	Value	Information
	 	
S. 10	Slope correction for measuring depth 10 mm	<i>factory setting: of= 0%</i>
	oF -19 ... +19	Value of slope correction in %
S. 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 there is no key pressed within the menu mode within 2 minutes, the configuration will be cancelled, the entered settings are lost!

15 Accuracy Inspection: Adjustment /Update Service

You can send the device to the manufacture 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 has to be changed. Measurements are no longer possible.

17 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 for high-resolution relative measurements
Resolution	0.1 %; for more than 19.9 %: 1 % (for both %u and %w)
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	-25 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 time: more than 2500 hours for alkaline battery)
Power consumption (backlight)	Approx. 2.5 mA (Backlight reduces battery life time! 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. 135g incl. battery
EMC	The device corresponds to the essential protection ratings established in the Regulations of the Council for the Approximation of Legislation for the member countries regarding electromagnetic compatibility (2004/108/EG), additional error: < 1% FS

18 Disposal Notes



Dispense exhausted batteries at destined gathering places.
 This device must not be disposed as 'residual waste'
 To dispose this device, please send it directly to us (adequately stamped).
 We will dispose it appropriately and environmentally friendly.

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 americ. / 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

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