# Operating Manual for Digital Moisture Meter for Wood GHH 91

The moisture meter for wood GHH 91 is a high precision measuring device for measuring the weight moisture in all types of wood. As a basis for its moisture measurements the GHH 91 device uses the electric conductivity of wood, which is determined by means of a special impact electrode. The various types of woods are categorised from A to D (four categories).

## Specification

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|---|---|
| **Measuring range:** | 3 to 100 % |
| **Resolution:** | 0.1 % |
| **Application:** (from | For approx. 130 types of wood altogether, four categories A to D) |
| **Moisture sensor:** | Impact electrode, plug-in via Cinch socket |
| **Accuracy:** | 3 to 25 % : 0.2 % <br> 25 to 60 % : 0.5 % <br> 60 to 100 % : 2.5 % |
| **Temperature compensation:** | -50 to +95° C; temperature sensor can be plugged via 3.5 mm monoplug. If temperature sensor is not plugged in via internal temperature sensor. |
| **Display:** | 3 1/2 digit LCD, approx. 13 mm high |
| **Nominal temperature:** | 25° C |
| **Working temperature:** | 0 to 45°C |
| **Power supply:** | 9 V-battery type IEC 6F22 (included in scope of supply) and |
| **Battery service life:** | Approx. 5000 measurements, 5 to 8 sec each |
| **Low battery warning:** | Automatic; "BAT" displayed in case of low battery voltage |
| **Dimensions of housing:** resistant | Approx. 150 x 86 x 30 mm (height x width x depth); impact ABS plastic housing with integrated pop-up clip for table-top or suspended operation. |
| **Weight:** | Approx. 240 g incl. battery |

## Accessories: (included in scope of supply)

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|---|---|
| Temperature sensor: | Sensor with approx. 1 m of cable |
| Measuring pins: dia; | 3 pieces, length 16 mm x 2.5 mm dia; length 22 mm x 2.5 mm length 28 mm x 2.5 mm dia |
| Impact electrode: <br><br> easily be <br><br> measurements. | Electrode for measuring electric conductivity in wood <br> The measuring pins are held in a chucking device and can exchanged. <br> Without pins the electrode can be used for surface |
| Measuring cable: plugs for | Approx. 1 m of special cable with Cinch plug and 2 banana connection of the electrode with the measuring device. |

## Special accessories:

| | |
|---|---|
| Insertion needles 300 mm fitted to | For measurements in matchwood or wood wool, can be screw-the electrode support instead of the tightening nut. |
| Insertion probe: via | For measurements in matchwood or wood wool; direct plug-in measuring cable. |
| Insertion sensor: long | For measurements in large bales of wood wool, approx. 1 m |
| Separate, extra long steel pins: via | For depth measurements in wood (over 80 mm); direct plug-in measuring cable. |
| Flat measuring caps: electrode support | For surface measurements; can be screw-fitted to the

instead of the tightening nut. |
| Brush-type electrodes: length cm | For measurements in building materials; for hard materials, 120 mm x 6 mm dia. Drill holes of 6 mm dia at a distance of 4 each. |
| Building material plugs: 91 | Building material compensation plug; to be connected to GHH when taking measurements in building material. |
| Heat conducting paste: caps | To be used with brush-type electrodes and the flat measuring (surface measurements) |

## Preparations for measurements:

1.  Select suitable electrode for your application.

    - impact electrode 16 mm:      for wood thickness up to 35 mm
    - impact electrode 22 mm:      for wood thickness over 35 mm
    - separate, long steel pins:      for wood thickness over 80 mm
    - insertion needles 300 mm:      for measurements in matchwood or wood wool
    - insertion probe:      for measurements in large bales of wood wool
    - insertion sensor:      for surface measurements

2.  Mount suitable electrode onto support (if necessary) and connect to measuring device.

## How to carry out measurements:

−   For depth measurements in wood impact electrode or steel pins have to be driven into material to be measured.
    When using the steel pins make sure drive them into the wood deeply and to maintain the same pitch as for the pins of the impact electrode. The impact electrode can be used to prick punch the impact points.
−   For surface measurements press electrode tightly against the surface to be measured. A degree of moisture in the wood of less than 25 % can be measured.
−   Make it a rule to always drive in/press on electrode pins/caps diagonally to the fibre direction of the wood to be measured.
−   When conducting wood measurements in drying ovens the temperature of the wood will be different from that of the GHH91; in order to ensure highest possible measuring accuracy we recommend connection of the temperature probe to the GHH91 for this application. For measurements insert measuring prod of the temperature sensor into a pre-drilled hole in the material to be measured or, for wood that has been piled up in layers, into a crevice.
−   If the material to be measured has ambient temperature and as soon as the GHH91 has adjusted to this temperature (after approx. 15 minutes), the temperature probe does not have to be connected.

In this case the temperature compensation will be carried out by means of the internal temperature probe.

- Set wood sector according to wood type table (approx. 130 different types of wood) using turning switch (A to D).
- Press measuring button on GHH91 and read off measured value as soon as display is stable; measuring time: 5 to 8 sec.

## Special points to be observed

1. When carrying out measurements in matchwood or wood wool, use insertion probes or long insertion needles.
   We recommend to pack matchwood ($1kg/cm^2$), a process not required for wood wool.

2. As soon as the display shows "BAT" the battery will have to be replaced as otherwise you run the risk of measuring inaccuracies.

3. If the display should drop below 0 (negative area) during measuring, this is an indication for static electricity, which sometimes occurs when the air and the wood is very dry (moisture below 10 %). In such a case avoid any movement of the measuring device to enhance measuring accuracy (humidify air, if possible).

## Preparations for measuring of building material

1. Select suitable electrode for your application.

   - impact electrode: with steel pins for soft building material, length of pins 16, 22 and
     28 mm for depth measurement.
   - flat measuring cap: for surface measurements
   - brush-type electrode: for hard building materials, length 120 mm x 6 mm dia

2. Mount suitable electrode onto support (if necessary) and connect to measuring device GHH91 via measuring cable supplied.

**Set moisture meter GHH91 to operating mode "building material measurements" by plugging red building material plug (see special accessories) into the corresponding socket and positioning turning switch to "B".**

## Building material measurements

- Drive impact electrode or steel pins into (soft) material.
- For surface measurements press electrode onto the surface to be measured using a small amount of conducting paste.
- When using brush-type electrodes apply thin layer of conducting paste to the brushes and insert brushes into pre-drilled holes. Make sure not to smear conducting paste over the surface to avoid measuring inaccuracies. (By means of the conducting paste the moisture lost due to the drilling of holes is restored, thus providing a safe electric connection between the building material and the brush.)
- Press measuring button on GHH91 and read off measured value as soon as display is stable. Refer to building material conversion table to convert value read off into measuring value.
- By no means must the material to be measured be frozen. Optimum measuring temperature ranges from 10
  to 30° C

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# Table for wood types:

| | | | | | |
|---|---|---|---|---|---|
| Aba | B | Oak (quercus spp.) | | Larch | C |
| Obeche (triplochiton scleroxylon) | B | Quercus ilex | C | Mockernut | B |
| Essia (stinkwood tree) | C | Common oak (quercus robur) | C | Niangon (tarrietia utilis) | B |
| Mitragyna ciliata (=Bahia) | B | Quercus petraea | C | Niove (staudita gabonensis) | B |
| Afr | A | Emien, patternwood (alstonia congensis) | C | Niove bidinkala | A |
| African afrormosia (pericopsis elata) | A | Alder, red (alnus glutinosa) | C | Okume (aucoumea klaineana) | B |
| Sifu (afzelia spp.) | B | Ash-tree | C | Oregon (douglassie) | C |
| Gossweilerodendron balsamiferum (=Tola branca) | C | Picea spp. | C | Rosewood (dalbergia spp) | B |
| Maple | C | Ash-tree | C | Poplar, cottonwood | C |
| Alder | C | Ash-tree | | Pau Amarela | B |
| Patagonian cypress (fitzroya cupressoides) | C | American ash-tree | B | Plum tree | C |
| Patternwood (=emien) | C | Japanese ash-tree | B | Stone pine | C |
| Amaranthus | C | Fromager, ceiba | C | Purpleheart (peltogyne spp.) | C |
| Crab wood | C | Yellow birch (betula lutea) | C | Rio rosewood (dalbergia nigra) | B |
| Trembling/quaking poplar (populus tremuloides) | C | Yellow pine (ponderosa pine) | C | Fagus silvatica | B |
| Mitragyna ciliata (=Bahia) | C | Hornbeech (carpinus betulus) | C | Red oak (quercus rubra) | B |
| Balsa | C | Beech | B | Red sandal | C |
| Angelique (dicarynia paraensis) | C | Hevea (coutchouc tree) | A | Elm | C |
| Briar (erica arborea) | C | Hickory (carya spp.) | | Maritime pine | C |
| Ebiara, ekaba, mubangu noir | C | Bitternut hickory | B | White poplar | C |
| Nigerian walnut (dibetou) | D | Swap hickory | B | Spanish oak | B |
| Birch | C | Poplar hickory | C | Stone beech | C |
| Pear-tree | B | Ilomba (pycnanthus angolensis) | B | Maritime pine | C |
| Black Afara | B | Imbuia, "Brazilian walnut" (phoebe porosa) | A | Teak (tectona grandis) | C |
| Logwood | C | Ipe, lapacho (tabebuia ipe) | B | Tola | |
| Eastern red cedar (juniperus) | C | Iroko, kambala (chlorophora excelsa) | B | Tola branca, agba gossweilerodendron balsamiferum) | C |
| Scrubby oak (lophira alata) | C | Izombé (testulea gabonensis) | C | Real tola | A |
| Parana pine (araucaria angustifolia) | B | Jacareuba (calophyllum brasiliense) | C | Tola, red | A |
| Beech | B | Jarrah (eucalyptus marginata) | C | Elm | C |
| Hornbeech (carpinus betulus) | C | Kambala (=Iroko) | B | Walnut | C |
| Hornbeech (carpinus betulus) | C | Karri (eucalyptus diversicolor) | C | Willow | B |
| Stone beech (carpinus betulus) | C | Chestnut | | "Western red cedar" (calocedrus decurrens) | C |
| White beech (carpinus betulus) | C | Sweet chestnut | C | White maple | C |
| Logwood (haematoxylon campechianum) | C | Horse chestnut | C | White birch | C |
| Canarium (burseraceae) | C | Keruing (dipterocarpus spp.) | C | White beech | C |
| African canarium | C | Khaya (khaya ivorensis) | C | White oak | B |

| Material | Grade | Material | Grade | Material | Grade |
|---|---|---|---|---|---|
| Cardboard | B | Pine | C | White poplar | C |
| Ceiba tree | C | Cherry tree | C | Cedar | B |
| Dabema (=dahoma) | B | African afrormosia | A | Cembra pine | C |
| Piptadenia africana (=dahoma) | B | Kosipo (entandrophragna candolei) | C | Trembling poplar | C |
| Daniellia, faro (danieallia ogea and thruringia) | C | Larch | C | Plum tree | C |
| Dark | C | Lapacho, ipe (tabebuia ipe) | B | Cypress | |
| Lovoa, zedrach, bibolo, "Nigerian walnut" | D | Afara, terminalia superba | C | *Cypress Lusit* | B |
| Douka, makore (dumaria heckelii) | C | Lime | B | *Echte Zypresse* | C |
| Ebony | B | American lime | B | | |
| Oak | | Mahogany | C | | |
| Northern red oak (quercus rubra) | B | "African pear" (tieghenella heckelii) | C | Paper | B |
| White oak (quercus alba) | B | Maple | C | Hard cardboard | C |

# Conversion Table for Building Materials

| Display | Adurapid-cement-wash floor | Anhidrit wash floor | Concrete 200 kg cement/m3 | Concrete 350 kg cement/m3 | Concrete 500 kg cement/m3 | Elastizell wash floor | Gas concrete (Hebel) | Gypsum | Gypsum wash floor | Wood cement wash floor | Xylolite wash floor | Lime mortar 1 : 3 | Cement mortar (wash floor) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 75.0 | 2.0 | 2.8 | 2.0 | 2.5 | 2.6 | 8.1 | - | 15.2 | 4.3 | 14.4 | 16.4 | 19.0 | 5.5 |
| 70.0 | 1.8 | 2.1 | 1.9 | 2.4 | 2.5 | 7.5 | 35.2 | 11.1 | 3.1 | 12.9 | 15.5 | 11.4 | 4.6 |
| 65.0 | 1.7 | 1.6 | 1.8 | 2.2 | 2.4 | 6.8 | 33.3 | 8.9 | 2.5 | 11.7 | 14.8 | 6.9 | 4.0 |
| 60.0 | 1.6 | 1.3 | 1.6 | 2.1 | 2.3 | 6.3 | 30.9 | 7.2 | 2.2 | 11.0 | 14.2 | 5.1 | 3.6 |
| 58.0 | - | 1.2 | - | - | - | 6.1 | 29.8 | 6.6 | 2.1 | 10.7 | 14.0 | 4.7 | 3.5 |
| 56.0 | 1.5 | 1.1 | - | - | - | 5.8 | 28.6 | 6.1 | 2.0 | 10.4 | 13.9 | 4.3 | 3.4 |
| 54.0 | - | 1.0 | 1.5 | 2.0 | 2.2 | 5.6 | 27.2 | 5.7 | 1.9 | 10.2 | 13.7 | 3.9 | 3.3 |
| 52.0 | - | 0.9 | - | - | - | 5.4 | 25.5 | 5.3 | 1.8 | 10.0 | 13.6 | 3.6 | 3.2 |
| 50.0 | 1.4 | 0.8 | 1.4 | 1.9 | 2.1 | 5.2 | 22.8 | 5.0 | 1.7 | 9.8 | 13.4 | 3.3 | 3.1 |
| 48.0 | - | 0.7 | - | - | - | 4.9 | 20.7 | 4.7 | 1.6 | 9.6 | 13.3 | 3.0 | 3.0 |
| 46.0 | 1.3 | 0.6 | - | - | - | 4.6 | 18.7 | 4.3 | 1.5 | 9.5 | 13.2 | 2.8 | 2.9 |
| 44.0 | - | - | 1.3 | 1.8 | - | 4.4 | 16.8 | 4.0 | 1.4 | 9.3 | 13.0 | 2.6 | 2.8 |
| 42.0 | - | - | - | - | - | 4.1 | 15.2 | 3.7 | 1.3 | 9.1 | 12.9 | 2.4 | 2.7 |
| 40.0 | 1.2 | 0.5 | 1.2 | 1.7 | 2.0 | 3.9 | 14.3 | 3.4 | 1.2 | 9.0 | 12.8 | 2.3 | 2.6 |
| 38.0 | - | - | - | - | - | 3.7 | 12.9 | 3.1 | 1.1 | 8.8 | 12.7 | 2.1 | 2.5 |
| 36.0 | 1.1 | 0.4 | - | - | 1.9 | 3.4 | 11.5 | 2.9 | - | 8.6 | 12.6 | 2.0 | 2.4 |
| 34.0 | - | - | - | - | - | 3.2 | 10.4 | 2.6 | 1.0 | 8.4 | 12.5 | 1.8 | 2.3 |
| 32.0 | - | 0.3 | - | - | - | 2.9 | 9.1 | 2.4 | - | 8.1 | 12.4 | 1.7 | 2.2 |
| 30.0 | 1.0 | - | 1.1 | 1.6 | 1.8 | 2.6 | 8.1 | 2.1 | 0.9 | 7.9 | 12.3 | 1.6 | 2.1 |
| 28.0 | - | - | - | - | - | 2.4 | 7.1 | 1.9 | - | 7.7 | 12.2 | 1.5 | 2.0 |
| 26.0 | 0.9 | 0.2 | - | 1.5 | - | 2.2 | 6.2 | 1.7 | 0.8 | 7.4 | 12.0 | 1.4 | 1.9 |
| 24.0 | - | - | 1.0 | 1.4 | 1.7 | 2.0 | 5.4 | 1.5 | - | 7.2 | 11.9 | 1.3 | 1.8 |
| 22.0 | - | - | - | - | - | 1.8 | 4.6 | 1.2 | 0.7 | 7.0 | 11.8 | 1.2 | 1.7 |
| 20.0 | 0.8 | - | - | 1.3 | - | 1.7 | 4.0 | 1.1 | - | 6.8 | 11.7 | 1.1 | 1.6 |
| 18.0 | - | - | - | - | 1.6 | 1.6 | 3.4 | 1.0 | - | 6.6 | 11.6 | 1.0 | 1.5 |
| 16.0 | 0.7 | - | 0.9 | 1.2 | - | - | 2.8 | 0.7 | - | 6.5 | 11.5 | 0.9 | 1.4 |
| 14.0 | - | - | - | 1.1 | - | 1.5 | - | 0.5 | - | 6.4 | - | 0.8 | 1.3 |
| 12.0 | - | - | - | - | - | - | - | 0.3 | - | 6.3 | 11.4 | - | 1.2 |
| 10.0 | 0.6 | - | 0.8 | - | - | - | - | - | - | - | 11.3 | 0.7 | 1.1 |
| 8.0 | - | - | - | - | 1.5 | - | - | - | - | 6.2 | - | 0.6 | - |
| 6.0 | - | - | - | - | - | - | - | - | - | - | 11.2 | - | 1.0 |
| 4.0 | - | - | - | - | - | - | - | - | - | 6.1 | - | 0.5 | - |

Values in weight percentage     Example: Value for gypsum 60 %  = 7.2 % actual value **Switch to "B" and plug in red plug !**
**When conducting depth and surface measurements in/at porous building materials - sensor has to be used with conductivity paste !**

moisture saturation durch weight moisture ersetzt.