Species Settings, Questions & Answers

for Wagner Models:

- MMC 205
- MMC 210
- MMC 220

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Questions and Answers

#1 Wagner Technology

Q: I'm nervous about buying a new technology. How long has Wagner Electronic Products been designing and manufacturing this type of moisture meter?

A: Since 1966, Wagner Electronic Products has been providing quality moisture measurement equipment. Wagner is the leading supplier of moisture measurement equipment for the primary forest products industry. Closely scrutinized and approved by numerous university studies and used for years by professional wood-grading associations, Wagner's meters continue to prove reliable and consistent, with unsurpassed convenience and ease-of-use.

#2 Theory of Operation

Q: How do Wagner Hand-Held Moisture Meters operate?

A: Wagner Hand-Held Moisture Meters send technologically advanced electromagnetic radio waves deep into the wood without leaving

destructive holes. Known around the world for speed and accuracy, Wagner meters supply instant readings, scanning large amounts of board feet in seconds. Virtually unaffected by temperature and * humidity, they scan right through finished products.

* For frozen wood with up to 15% moisture content, accurate measurements can be obtained. When the frozen lumber moisture content is suspected to be over 15%, a relative reading can be obtained. Contact Wagner technical support if additional guidance is needed.

#3 Gradients and Wet Pockets

Q: What about gradients and wet pockets?

A: Although the various drying processes for green lumber can leave wet cores and pockets, moisture continues to pass from fiber to fiber within the wood until it has equalized through out the whole board, and then to surrounding humidity levels. Determining if a board or load of lumber will equalize within tolerance levels can be difficult and tricky, but Wagner Moisture

Meters provide this information automatically. Penetrating deep into the wood, they mathematically determine equalized moisture content and are capable of checking truckloads of board feet for specified moisture content in minutes. For even more convenience, many companies use their Wagner Hand-Held Meters to read right through the plastic wrapping around the wood on new deliveries before they allow unloading!

#4 Where to Take Readings

Q: Where is the reading taken with my Wagner Moisture meter?

A: Wagner models MMC-205, MMC-210, and MMC-220 hand-held moisture meters generate a three-dimensional field under the entire sensor that measures a 1 1/2" wide, 2 1/2" long, 3/4" (minimum) thick volume of wood under the entire sensor. The meters can be held in one place or slid rapidly along the entire length of the wood product, on both finished and unfinished wood, for stable, accurate readings.

#5 Surface Moisture

Q: Is my Wagner Moisture Meter affected by surface moisture?

A: Most moisture meters can be affected by standing water or visible water on the board. You should always wipe off as much excess water as possible. Once the standing water is removed, your Wagner Moisture Meter will read slightly higher than normal, whereas other types of meters can show greatly exaggerated readings. An exception to this is the Wagner Model L607. This unit was designed to measure surface moisture to test the cure of waterborne finishes.

NOTE: If water is allowed to soak into the wood, it will naturally show higher moisture content. If a piece of wood is quite rough, it will soak up the water quite readily, affecting readings for all meters.

#6 Narrow Lumber

Q: What is the narrowest piece of lumber I can measure accurately with my Wagner hand-held moisture meter?

A: The MMC-200 Series meters measure boards as narrow as 1½ inches in width.
Contact Wagner for information to measure lumber narrower than 1½ inches.

#7 Board Thickness

Q: What board thickness can I measure?

A: The MMC-200 Series meters are designed to measure wood from ¾ inch to 1½ inches thick.

#8 Meter Orientation

Q: What about the orientation of the meter on the wood?

A: Your Wagner MMC-200 Series moisture meter uses advanced electromagnetic wave technology and is virtually unaffected by orientation (cross-grain or with the grain) on the wood.

Questions and Answers Continued. . .

#9 Meter Ruggedness

Q: How rugged is my MMC-200 Series moisture meter? Is it too delicate to be used on an abusive production line?

A: Your MMC-200 Series meter is designed for compact convenience. It can be damaged by being dropped or slammed down hard on wood surfaces, as can any meter. If a large volume of wood is to be measured, an in-line system should be used.

#10 Meter Safety

Q: Is the Wagner technology safe to use?

A: Wagner's electromagnetic wave technology produces less electromagnetic radiation than standard house wiring.

#11 Correct Moisture Content

Q: What is proper moisture content for wood? What moisture content is considered too high or too low?

A: There is no one right answer for this question. As a rule, different woods and their uses determine the moisture content. For instance, if the wood is to be used in construction as a stud for building, the moisture-content requirement could be 15% to 19%. If the wood is to be glued and it is too dry, it will not bond; if it is too wet, it will not hold. Ideally, the moisture content of wood to be used for indoor furniture is between 6% and 8%.

To determine the proper moisture content for your application, contact your local university's forestry department or one of the associations supporting your industry's professionals. You may also call the Forest Products Research Laboratory in Madison, WI: 608-231-9200.

Species Setting Tables

Hardwood Species

Spec. Gravity	Hardwood Species
0.41	Alder, Red
0.61	Apple
0.49	Ash, Black
0.58	Ash, Blue
0.56	Ash, Green
0.55	Ash, Oregon
0.55	Ash, Red
0.60	Ash, White
0.39	Aspen, Bigtooth
0.38	Aspen, Quaking
0.37	Basswood, American
0.64	Beech, American
0.55	Birch, Paper
0.65	Birch, Sweet
0.55	Birch, White
0.62	Birch, Yellow
0.38	Butternut
0.50	Cherry, Black
0.43	Chestnut, American
0.34	Cottonwood, Balsam Poplar
0.35	Cottonwood, Black
0.40	Cottonwood, Eastern
0.64	Dogwood, Flowering
0.50	Elm, American
0.63	Elm, Rock

Hardwood Species

Spec. Gravity	Hardwood Species
0.53	Elm, Slippery
0.53	Hackberry
0.66	Hickory (Pecan), Bitternut
0.60	Hickory (Pecan), Nutmeg
0.66	Hickory, Pecan
0.62	Hickory (Pecan), Water
0.72	Hickory (True), Mockernut
0.75	Hickory (True), Pignut
0.72	Hickory (True), Shagbark
0.69	Hickory (True), Shellbark
0.50	Holly, American
0.63	Hophornbeam, Eastern
0.51	Laurel, California
0.69	Locust, Black
0.58	Madrone, Pacific
0.50	Magnolia, Southern
0.48	Maple, Bigleaf
0.57	Maple, Black
0.66	Maple, Hard
0.54	Maple, Red
0.47	Maple, Silver
0.51	Maple, Soft
0.63	Maple, Sugar
0.61	Oak (Red), Black
0.51	Oak, California Black

Species Setting Tables cont'd. . .

Hardwood Species

Spec. Gravity	Hardwood Species
0.68	Oak (Red), Cherrybark
0.63	Oak (Red), Laurel
0.63	Oak (Red), Northern Red
0.63	Oak (Red), Pin
0.67	Oak (Red), Scarlet
0.59	Oak (Red), Southern Red
0.63	Oak (Red), Water
0.69	Oak (Red), Willow
0.64	Oak, Red (1).
0.64	Oak (White), Bur
0.66	Oak (White), Chestnut
0.63	Oak (White), Overcup
0.67	Oak (White), Post

Softwood Species

Spec. Gravity	Softwood Species
0.46	Baldcypress
0.44	Cedar, Alaska
0.32	Cedar, Atlantic White
0.47	Cedar, Eastern Red Cedar
0.37	Cedar, Incense
0.31	Cedar, Northern White
0.43	Cedar, Port Orford
0.32	Cedar, Western Red Cedar

(1). See page 17 for footnote sources.

Hardwood Species

Spec. Gravity	Hardwood Species
0.67	Oak (White), Swamp Chestnut
0.72	Oak (White), Swamp White
0.66	Oak, White
0.64	Persimmon, Common
0.46	Sassafras
0.52	Sweetgum
0.49	Sycamore, American
0.58	Tanoak
0.50	Tupelo, Black
0.50	Tupelo, Water
0.55	Walnut, Black
0.39	Willow, Black
0.42	Yellow-Poplar

Softwood Species

Spec. Gravity	Softwood Species
0.44	Cedar, Yellow
0.50	Douglas Fir
0.35	Fir, Balsam
0.38	Fir, California Red
0.37	Fir, Grand
0.39	Fir, Noble
0.43	Fir, Pacific Silver
0.32	Fir, Subalpine

Species Setting Tables cont'd. . .

Softwood Species

Spec. Gravity	Softwood Species
0.39	Fir, White
0.40	Hemlock, Eastern
0.45	Hemlock, Mountain
0.45	Hemlock, Western
0.52	Larch, Western
0.35	Pine, Eastern White
0.43	Pine, Jack
0.51	Pine, Loblolly
0.41	Pine, Lodgepole
0.59	Pine, Longleaf
0.52	Pine, Pitch
0.56	Pine, Pond
0.40	Pine, Ponderosa
0.46	Pine, Red
0.48	Pine, Sand

Imported Species

Spec. Gravity	Imported Species
0.69	Afrormosia
0.64	Andiroba
0.54	Anegre
0.55	Avodire
0.62	Banak (Cuangare)
0.77	Benge (Ehie, Bubinga)

Softwood Species

Spec. Gravity	Softwood Species
0.51	Pine, Shortleaf
0.59	Pine, Slash
0.44	Pine, Spruce
0.36	Pine, Sugar
0.48	Pine, Virginia
0.38	Pine, Western White
0.40	Redwood, Old-Growth
0.35	Redwood, Young-Growth
0.42	Spruce, Black
0.35	Spruce, Engelmann
0.40	Spruce, Red
0.40	Spruce, Sitka
0.36	Spruce, White
0.51	SYP (Southern Yellow Pine)
0.53	Tamarack

Imported Species

Spec. Gravity	Imported Species
0.61	Caribbean Pine
0.44	Cativo
0.91	Courbaril (Jatoba)
0.51	Cypress
0.82	Degame
0.58	Determa

Species Setting Tables cont'd. . .

Imported Species

Spec. Gravity	Imported Species
0.70	Ebony, East Indian
0.50	Gmelina
0.38	Hura
1.00	Ipe
0.70	Iroko
0.80	Jarrah
0.46	Jelutong
0.76	Kapur
0.84	Kempas
0.64	Keruing (Apitong)
0.67	Koa
0.67	Lauan, Dark Red
0.50	Lauan, White (Light Red Meranti)
0.45	Limba
0.61	Mahogany, African
0.93	Mahogany, Santos
0.59	Mahogany, True
0.68	Manni
0.80	Merbau
0.65	Mersawa
0.63	Mueri (Cherry)
0.38	Obeche
0.66	Ocote Pine
0.44	Okoume
0.73	Opepe
0.54	Parana Pine
0.63	Peroba de campos

Imported Species

Spec. Gravity	Imported Species
0.75	Peroba rosa
0.45	Primavera
0.80	Purpleheart
0.48	Radiata Pine
0.65	Ramin
0.64	Roble (Quercus)
0.85	Rosewood, Brazilian (Jacaranda)
0.85	Rosewood, Indian
0.61	Santa Maria
0.62	Sapele
0.41	Spanish Cedar
0.59	Teak
0.67	Yew

Plywood and OSB

Spec. Gravity	Plywood and OSB
0.57	Southern Yellow Pine CDX Plywood (2).
0.57	Douglas Fir CDX Plywood (2).
0.70	Southern Yellow Pine OSB (2).
0.70	Douglas Fir OSB (2).

Specific Gravity Correction Value Sources

(1). This SG correction value was developed by Wagner Electronic Products, Inc.

(2). This SG correction value was developed by Wagner Electronic Products, Inc. These values are based on our research and have been developed to give users a general correction factor for plywoods & OSB. Please keep in mind that plywood & OSB manufacturing processes can differ slightly and some plywood and OSB of the same species may vary slightly.

Species Corrections

The dry specific gravity (density) values for a species are based on the best, current world data, and are used to determine the species correction factor within the meter. The values provide average density values for the species. A coefficient of variation (COV) of about 10% describes the variability inherent in many common domestic (US) species.

If the specific gravity of your lumber is not listed in the Species Settings Tables provided or you are dealing with an unknown species, the value may be determined by referring to the “Determining the Specific Gravity” section of this manual. Additional resources are: the Forest Products Lab at http://www.fpl.fs.fed.us/ and the Wood Handbook at http://www.fpl.fs.fed.us/documnts/fplgtr/fplgtr113/fplgtr113.htm

The MMC-200 series meters can be used to measure non-wood materials if the density is similar to wood products. Non-wood species can be measured by using the meter reading as a relative value such as in “go/no-go” applications, or when determining if one measurement area contains more moisture than another, i.e. measurements that do not require a high absolute accuracy. SG formulas can’t be applied to non-solid wood species due to the presence of glues and resins, which cause a non-linear moisture content curve. If greater accuracy is required, the ASTM oven-dry procedure can be used to determine a meter correction value for non-solid woods.

Please contact Wagner Electronics at (541) 582-0541 for additional information on species corrections if needed.

Commentary on Species Adjustment

In 1992, a study was conducted at the Forest Research Laboratory of Oregon State University on species correction for the Wagner Hand-Held Moisture Meters. The species tested were Douglas Fir, Lodgepole Pine, Western Red Cedar, Western Hemlock, White Fir, Western Larch, Engelmann Spruce, and White Oak. Three to four 40-piece samples of each species were tested. Specific gravity was found to be the primary factor on species adjustment. A species equation as a function of specific gravity and the meter reading was obtained using multiple-regression technique (R-square = 0.95) as follows:

AF = 8.77 + (0.25 * MM) - (15.86 * SG) - (0.62 * SG * MM)

in which

AF = Species Adjustment

MM = Meter Reading

SG = Specific Gravity in oven dry weight and 12% moisture-content volume basis.

The species adjustments provide the adjusted moisture measurements that are based on the species adjustment determined using the species adjustment equation, with rounding to the nearest 0.5.

Wood is not a uniform material. Specific gravity of solid-sawn lumber varies within the piece and among pieces. In the OSU study, the average specific gravity for each species differed from the individual sample by plus or minus 1% to plus or minus 8%. For general applications, average specific gravity values can be found in the Wood Handbook (USDA Agriculture Handbook No. 72, 1999). Except for one species for which the experimental value is 7% higher, the species' overall average specific gravity values obtained in the OSU study are comparable with those in the Wood Handbook. The exception may be caused by

unknown biases in the sampling scheme. The Wood Handbook values are used in the tables, except for the imported species, unless otherwise noted.

Species adjustment can be determined for lumber sorted, or otherwise known, to have specific gravity different from the species' average. One example is lumber graded under the Dense rules. If the specific gravity of a lumber sample is known, species adjustment can be determined by the species adjustment equation.

The species adjustment equation provides a way to expand the use of your Wagner Hand-Held Moisture Meter for lumber of any species groups having similar species-specific gravity values. One example is Hem-Fir. For a species group, one way to determine the species adjustment is by the use of a weighted average of the individual species' average specific gravity values. The weighing procedure used in the ASTM D2555 by standing timber

volume can be used. Species adjustment is not recommended for any species group having a broad range of species-specific gravity values. There are no recognized limits on species group species adjustment. Species adjustment for species groups should be used with knowledge on the variability on species involved and the affect of it on species adjustment. If the species mix in the lumber production of a species group is controlled or known to have specific gravity different from that used for the species group, a better estimation of species adjustment can be determined using the known specific gravity in the above species correction equation.

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Determining Specific Gravity

Determining the Species Setting for an Unknown Species

The Species Setting Tables based on specific gravity of solid wood, are provided in this manual. If you don't know the species of the wood you are using, or the specific gravity differs from the handbook because of a different growing region, use the following procedure.

Determining the Specific Gravity

1. Select a sample of wood that is approximately 12% moisture content, with all edges being true. Carefully measure the dimensions of the sample using a caliper. You will need the length, width, and thickness.
2. Convert these measurements to feet.
3. Carefully measure the weight of the sample.
4. Convert the weight to pounds.
5. Calculate specific gravity.

Example:

Length = 10 in. 10 in. / 12 in. = 0.833 ft.

Width = 7½ in. 7½ in. / 12 in. = 0.625 ft.

Thickness = 1½ in. 1½ in. / 12 in. = 0.125 ft.

Volume = L x W x T

0.833 x 0.625 x 0.125 = 0.065 cu. ft.

Weight = 20 oz. 20 oz. / 16 oz. = 1.25 lb.

Specific Gravity:
(Weight / Volume) / Specific Gravity of water
(1.25 lb. / 0.065 cu. ft.) / 62.34 lb. / cu. ft. = 0.31

In order to ensure that the value obtained for the specific gravity is statistically significant, a number of pieces must be measured and the average determined. Use this value of specific gravity for the species setting in the meter.

Checking the Moisture Content in Veneer

You can check the moisture content of veneer with your Wagner hand-held moisture meter as follows:

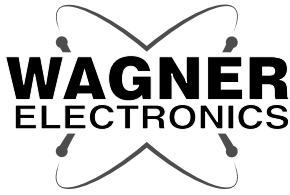
1. Put veneer into a tight stack of at least ¾ inch, and separate the stack by at least 3 inch to 4 inch from the rest of the stack. Measuring a stack less than the scan depth of the meter will give you a reading that is lower than the true moisture reading. Refer to the species adjustment table for the wood you are using.

2. Electro Static Discharge (ESD) needs to be prevented, as Wagner's warranty doesn't cover ESD damage.
   The instruments are tested to withstand a 15 KV static charge but not the typical 150 - 250 KV found in a veneer charge.

The veneer table should be earth grounded with a metal wand attached by wire to the table. The wand must then be run up and down the edge of a veneer stack to discharge static, or the person using the moisture meter must have a Velcro wrist band with a tethered strap which is grounded.

These same static precautions apply to lumber moving from a planer; the hand-meter is not an in-line measurement system. This unit is meant to check lumber while stationary.

If these guidelines are adhered to, the risk of ESD damage to your moisture meter is greatly reduced or eliminated. Please call the factory if you have any questions or concerns about this information.



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