






SKIPPER 5 MOISTURE METER FOR MARINE SURVEYING



- SMM5 - USER GUIDE

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INTRODUCTION

Hi there! Thank you for trusting our brand and choosing the Skipper 5, SMM5, from Tramex. It is our goal to ensure that you are always happy with what you bought from us, so please let us know if you have any questions and rest assured, we are always here to help.

The Skipper 5 is a moisture detection instrument that uses the latest in electronic technology to take non-destructive moisture readings in GRP (Glass Reinforced Plastic) and wooden boats. It enables you to quickly check hulls and decks both inside and outside for trapped moisture. Your Skipper 5 meter features three Scales enabling you to select the correct scale for the material and environment in which you are working.



1. **%MC** HARDWOOD:

Gives you the percentage moisture content in Wood.

2. SHALLOW DEPTH:

Designed to have a field penetration of up to 10mm (0.4 inches) on the comparative scale. This non-destructive accuracy and precision is comparable to actual pin readings.

3. G.R.P. (Glass Reinforced Plastic) :

A comparative scale for moisture detection to indicate moisture levels in G.R.P. decks and hulls.

THE TRAMEX METERS APP

Visualize, photograph and Geo-tag your meter readings: On pairing any of your Skipper 5 to the Tramex Meters App, the meter name will appear on the screen of your phone or tablet.

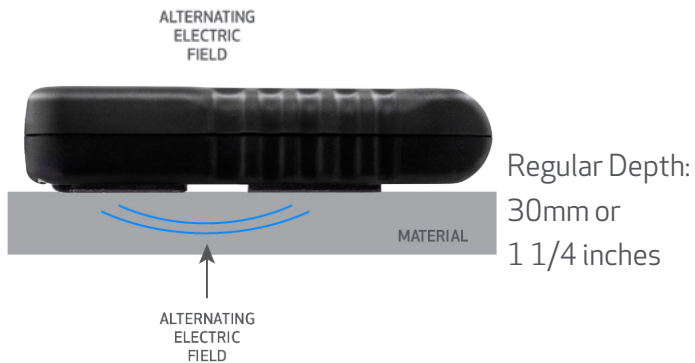
You can take a photograph of the meter in the testing location. The photo shows the readings displayed on the bottom left hand corner of the screen and will be time-stamped by your device. It is possible to Geo-tag the image, providing vital supportive documentary evidence for your moisture measurements and readings.

SKIPPER 5 - HOW IT WORKS

The instrument operates on the principle that the electrical impedance of a material varies with its moisture content. To measure / detect moisture, the three co-planar conductive rubber electrodes mounted on the base of the instrument case are pressed onto the wood or GRP sample. The instrument measures the electrical impedance of the material being tested by creating a low frequency alternating electric field between the electrodes.

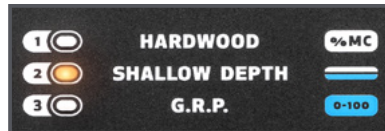
This field penetrates the material under test up to a depth of approximately 30 mm (1.25 inches), depending on material being tested and range used, or 10 mm (0.4 inches) in Shallow Depth mode. The very small current flowing through the field is inversely proportional to the impedance of the material. The instrument detects this current, determines its amplitude and, after processing, drives the pointer of the moving coil meter to the computed moisture value.

Skipper 5



As there is a wide variation in the nominal electrical impedance of different material types, the instrument is provided with three selectable scales which are optimized for testing:

1. Hardwood
2. Shallow Depth
3. G.R.P.



SHALLOW-DEPTH FUNCTIONALITY

The Skipper 5 incorporates **non-destructive dual-depth** functionality. The **regular** non-destructive penetration depth is 30mm (1 1/4 inches) when using:

Scale 1 - Hardwood;
 Scale 3 - G.R.P;

(The depth of field penetration will depend on the density of the material being tested.)

Scale 2 - The **Shallow Depth** scale is designed to have a field penetration of up to 10mm (0.4 inches).

Shallow depth penetration allows for:

- Comparative readings at different depths to help establish the depth of any moisture within GRP composites or other structure materials.
- Moisture testing with a smaller footprint for greater accuracy and precision of the readings within GRP composites or other structure materials. This non-destructive accuracy and precision is comparable to actual pin readings.

NOTE:

While the Shallow Depth scale reduces the influence of any deep moisture beyond 10mm (0.4 inches), the regular depth does not eliminate the moisture near or on the surface. The regular depth gives readings from the surface to a depth of up to 30mm (1 ¼ inches).

Using the **Dual-Depth** functionality by switching between the appropriate 'regular depth' scale and shallow depth scale, allows for a comparative of 'surface' versus 'surface + core' moisture.

- Shallow Depth reads the surface or top 10mm only.
- 'Regular depth' scales read the surface and the core up to 30mm.
- A comparative of moisture conditions both 'surface' and 'surface + core' can be made on this basis.

DIAGNOSIS

Your Skipper 5 can be used to diagnose trapped moisture which can contribute to osmosis in GRP boats and rot and decay in wooden boats and wooden components. The Skipper 5 is also essential in monitoring drying out of hulls and other boat components prior to remedial treatment.

Osmosis in GRP

Use Scale 3 G.R.P. **0-100** when checking GRP boats. Osmosis is a general term used to categorise a condition where GRP degrades under water. This degradation is caused by water penetrating the gel coat and reacting chemically with uncured resins, binders and other elements in the GRP lay-up. Once reaction takes place, pressure builds up and eventually blisters form. Osmosis is most often found on the underwater area of the hull or immediately above the waterline. If the Skipper 5 gives a high reading, it may indicate osmosis. It is recommended that the immediate area is thoroughly examined for blistering or other evidence of osmosis. (Note that some anti-foulings may give elevated readings due to the presence of conductive material in its composition. In these circumstances, it is suggested that the anti-fouling be removed and further testing carried out on the area.)

The Skipper 5 can be used to monitor the drying out prior to the remedial treatment. Tramex Ltd. cannot accept any responsibility for incidental or consequential damage or cost caused as a result of using this instrument.

Wooden Boats

Use Scale 1 Hardwood **%MC** for Wooden boats. Moisture readings for wood should be read from the top scale of the meter marked Wood %MC, which gives percentage of moisture by weight from 5% to 30%. In wooden boats, excess moisture trapped in the wood itself or beneath layers of paint or within joints in keel, bow etc. can lead in time to rot, decay and structural damage. As with a GRP boat, your Skipper 5 is a useful preventative maintenance tool which can be used for the annual examination of the hull above and below the waterline, decks, cabin and inside and outside the boat. The Skipper 5 can also be used to ensure the wood is sufficiently dry to accept paint or other coatings.

Important

Always drain water from the bilges before inspecting a boat as water from within the boat could be detected through the hull by your Skipper 5. You may get a slightly different reading from some species of wood which may be of higher or lower density than 0.6 S.G. (Hardwood), at which your Skipper 5 is calibrated. See notes on Specific Gravity and reading adjustment on page 21.

INSTRUMENT FEATURES

Your Skipper 5 employs advanced analog and digital technology to enable the incorporation of the many features listed below:

- There are 2 scales on the meter face. A Wood Scale and Comparative Scale. Refer to the top Wood scale when measuring moisture in wood using Scale 1 - Wood, Timber; or when measuring wood using Scale 2 - Shallow Depth. Refer to the bottom Comparative Scale when testing all other materials or when measuring other materials using Scale 2 - Shallow Depth.



- Four simple pushbutton controls, ON/OFF, SCALE, HOLD/AUDIO and Bluetooth.
- Non-destructive moisture readings taken in wood from 5% to 30% are displayed on a moving coil meter with linear scale.
- Audio signal sounds when meter indicates high reading.
- Comparative readings between 0 and 100 can be taken in GRP.

- Automatic supply timeout (5 minutes) conserves battery life.
- Bluetooth connectivity, Tramex Meters App available to download for iOS and Android
- Supply timeout is automatically extended if a change in meter reading is detected or if any button is pressed.
- 10 second bleep warning on instrument sounder prior to end of supply timeout period.
- Last used scale is memorized at supply timeout and automatically selected next time ON/OFF button is pressed. If Bluetooth was selected prior to the Skipper 5 automatically powering off it will be restored next time ON/OFF is selected.
- LEDs illuminate for selected scale.
- HOLD/AUDIO button freezes moving coil meter and LED will flash. HOLD facilitates readings taken out-of-sight.
- If HOLD/AUDIO was selected prior to supply timeout, the frozen meter reading is digitally memorized and restored next time ON/OFF is selected.
- If the battery voltage is getting low, the three LEDs flash sequentially for a short period. The Skipper 5 will continue to operate for some time but it is recommended that the batteries be changed as soon as convenient.

OPERATING INSTRUCTIONS

The instrument face with brief notes on the push button controls and LED indicators is shown below.



- 1 = Moving coil meter.
- 2 = LED Scale Indicators.
- 3 = Bluetooth ON/OFF button
- 4 = Bluetooth LED
- 5 = Hold/Audio button.
- 6 = Power ON/OFF button.
- 7 = Scale Select button.

SCALES AND SENSITIVITY

Scale 1, when used with wood, will give a %MC reading.



Scales 2 and 3 have a preset sensitivity appropriate to the density of G.R.P.

OPERATING INSTRUCTIONS

1. Press the ON/OFF button to power up. The LED for the last used scale will light.
2. To change the scale, press the the Scale Select button until the LED opposite the required scale lights.
3. Hold your Skipper 5 directly on the material being tested ensuring the electrodes on the base are fully in contact with the surface. The meter should be held by the rubber grips when taking readings. It is advised to not slide the meter across the surface under test. Place the meter on the surface, record the reading, lift and repeat.
4. For wood or wood products read the moisture content from the upper line (Wood) of the meter dial which is marked from 5% to 30%. Audio signal will sound when meter indicates high reading.
5. To turn audio signal on or off, press HOLD/AUDIO button twice in quick succession.
6. To turn Bluetooth On/Off, press the Bluetooth button. The blue LED will illuminate when on.
7. For G.R.P. comparative readings are taken from the lower line on the meter dial, which is marked from 0 to 100.

9. The instrument will automatically power-off after five minutes if no button is pressed or if no change in meter reading is detected. If a button is pressed or the meter reading changes, the power-off will be extended for a further five minutes.
10. To freeze readings press the HOLD/AUDIO button once. While on Hold, the LED for the selected scale will flash slowly. This facility is extremely useful if readings are being taken in areas where it is difficult to see the instrument dial. To remove freeze, press the HOLD/AUDIO button again..

Best Practice

It is advised when using the Skipper 5 with the App to avoid sliding or dragging the meter across the surface under test. Place and press the meter on the surface, record the reading, lift and repeat.

WORKING WITH YOUR SKIPPER 5

SCALE 1 - HARDWOOD **%MC**

- a. When testing Wood, select Scale 1 and lightly press the rubber electrodes directly to the surface. Read the moisture % from the top line of the analog dial where calibration is marked from 5% to 30%. If readings are in the high range (red) and if the audio is turned on, it will sound when readings go above 18%.
- b. If switched on, the audio signal will sound when readings are above mid-scale.
- c. For better accuracy, always take readings with the length of the instrument parallel to the direction of the wood grain.
- d. Acceptable levels of moisture content depend on climatic conditions and we advise you to check the levels acceptable in your area. The table on page 21 shows the approximate relationship between the ambient relative humidity and equilibrium moisture content in woods.
- e. As a rule of thumb and depending on climatic conditions, exterior wood is generally considered safe for painting when the moisture content is 14% or below. Wood below 10% is generally considered suitable for interior painting. (Always check coating manufacturers recommendations).

- f. The following moisture content levels are given as a guide:
 - Indoors wood: 6% in low humidity areas. Up to 12% in higher humidity locations.
 - Exterior wood: 10% to 15% depending on local humidity levels.
 - Generally, wood moisture content in excess of 23% - 27% is susceptible to rot.
 - Wood moisture content in excess of 18% - 20% may support mold and biological growth.
 - Wood above 28% moisture content is considered to have reached fibre saturation point.

When taking readings in chemically treated wood, it is advisable to allow for possible effects that the treatment may have on readings. The presence of different treatments, adhesives, etc. on or within products could affect measurements.

Wood Decking

Excess moisture in wood decking or wooden ribbing or framework can cause major problems, as will moisture trapped in balsa cored construction.

Depth Of Field Penetration

Depending on the density of the material being tested, the instrument field can penetrate up to approximately 30mm (1.25 inches) below the surface.

Your Skipper 5 can be used to measure the elevated moisture of all the wooden parts in your boat, even those encased in GRP. Likewise it can be used to check elevated moisture in other electrically non-conductive materials.

Relationship between Relative Humidity and Moisture Content

The table below shows the approximate relationship between the relative humidity and the equilibrium moisture content of some woods. (These figures are approximate values at a temperature of 70°F (21°C) and may vary for different species.).

| Relative Humidity | Wood MC % |
|-------------------|-----------|
| 10% | 3 to 5 |
| 20% | 5 to 6 |
| 30% | 6 to 8 |
| 40% | 8 to 9 |
| 50% | 9 to 11 |
| 60% | 11 to 13 |
| 70% | 13 to 15 |
| 80% | 16 to 19 |
| 90% | 20 to 22 |
| 100% | 25+ |

Relative Humidity / Wood Moisture Content Relationship

Notes on Specific Gravity (S.G.)

The S.G. of Hardwood used in boat building varies between species and this has an effect on moisture meter readings. The Skipper 5 calibration is based on Wood having an SG of 0.60.

Wood is normally categorised as follows:

| Density | SG @ 12% MC |
|---------------------|--------------|
| Exceptionally Light | 0.30 or less |
| Light | 0.30 to 0.45 |
| Medium | 0.45 to 0.65 |
| Heavy | 0.65 to 0.90 |
| Exceptionally Heavy | 0.90 or more |

Wood Density Categorisation.

Wood Specific Gravity (SG) Table

When testing wood, which does not have an SG of 0.60, the meter reading can be adjusted by referring to the table shown below. For example, if the wood being tested has an SG of 0.80 and the meter reading is 16% (top row of table) then the adjusted moisture content reading can be found where the 0.80 SG row intersects with 16% meter reading column. For this example the adjusted moisture content would be 13%.

| Meter Reading On Wood Scale (%H2O) | | | | | | | | | | | | | |
|------------------------------------|-------------------------------------|----|----|----|----|----|----|----|----|----|----|----|----|
| | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
| S.G. | ADJUSTED/CORRECTED MOISTURE CONTENT | | | | | | | | | | | | |
| 0.3 | 10 | 13 | 16 | 18 | 21 | 23 | 26 | 30 | 32 | 35 | 39 | 41 | 44 |
| 0.4 | 8 | 10 | 14 | 16 | 18 | 20 | 24 | 26 | 29 | 32 | 34 | 37 | 40 |
| 0.5 | 7 | 9 | 12 | 14 | 16 | 18 | 21 | 24 | 26 | 29 | 31 | 34 | 36 |
| 0.6 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 |
| 0.7 | 5 | 7 | 9 | 11 | 13 | 14 | 17 | 18 | 20 | 22 | 23 | 25 | 26 |
| 0.8 | 4 | 6 | 8 | 10 | 12 | 13 | 15 | 16 | 18 | 20 | 21 | 23 | 24 |
| 0.9 | 4 | 5 | 7 | 9 | 11 | 12 | 14 | 15 | 16 | 18 | 20 | 22 | 23 |

Wood Specific Gravity Adjustment Table

SCALE 2: SHALLOW DEPTH

The Skipper 5 can be used in the Shallow Depth scale to detect moisture on or just below the surface. This dual-depth feature gives the user more versatility, allowing for a better understanding of moisture conditions at different depths. This can be of great benefit in verifying if high moisture readings within GRP composites or other structure materials are as a result of deep set moisture, surface moisture or conductive coatings.

When using both shallow and regular scales the user can get a comparative of moisture conditions up to a depth of 10mm (0.4 inches) and moisture conditions up to a depth of 30mm (1 1/4 inches).

In addition the shallow-depth feature operates on a smaller footprint for greater accuracy and precision of the readings within GRP composites or other structure materials. This non-destructive accuracy and precision is comparable to actual pin readings.

Shallow Depth scale is also very useful when checking if the surface is dry prior to painting or coating. Tests should be carried out on a comparative basis selecting the most appropriate scale, and readings should be taken from the 0 to 100 comparative scale on the meter dial.

NOTE:

While the Shallow Depth scale reduces the influence of any deep moisture beyond 10mm (0.4 inches), the regular depth does not eliminate the moisture near or on the surface. The regular depth gives readings from the surface to a depth of up to 30mm (1 ¼ inches).

Using the Dual-Depth functionality by switching between the appropriate 'regular depth' scale and shallow depth scale, allows for a comparative of 'surface' versus 'surface + core' moisture.

- Shallow Depth reads the surface or top 10mm only.
- 'Regular depth' scales read the surface and the core up to 30mm.
- A comparative of moisture conditions both 'surface' and 'surface + core' can be made on this basis.

SCALE 3 - G.R.P. (GLASS REINFORCED PLASTIC) 0-100

- a. The presence of moisture trapped between the lay-up and the gel coat can cause blistering in the coating of the hull. Your Skipper 5 can be used to locate unwanted moisture.
- b. When moisture has penetrated the gel coating, severe blistering will result. Testing the hull surface below the waterline and comparing the readings with the dry areas above the waterline can assist in identifying areas of osmosis.

Because of its deep signal penetration (up to 30mm or 1.25"), your Skipper 5 can identify areas where osmosis, or the potential for osmosis development, is present. Readings should be taken from the comparative scale (0 to 100) on the meter dial.

SURVEYING GUIDELINES

Boat hulls should be thoroughly pressure washed with fresh water to remove all weed, slime and salt. Allow the hull to become completely dry before taking any readings. Make sure that bilges are thoroughly dry and well ventilated before the test. Do not take readings in wet or very humid conditions, or at sub-zero temperatures.

Starting at the bows, take readings from the topsides, and work downwards to the centreline or keel at regular intervals. Repeat every half a meter or so along the boat's length on both sides of the hull. Note down all readings and record weather conditions at the time of test.

Persistently high moisture readings may indicate an osmotic condition, but any diagnosis must include a thorough visual examination. Bilge water and internal condensation may also cause high readings.

Older boats laid-up with Orthophthalic resins, and boats coated with epoxies may show high moisture readings for several weeks after lifting out. If necessary, readings should be repeated after a period on hard standing.

NOTES

- a. Your Skipper 5 is calibrated to give %MC moisture readings when set on Scale 1 in Hardwood of 0.6 S.G. This reading is displayed on the upper scale of the meter and is marked %MC Wood. When taking readings on other boat construction materials such as GRP or composite, the readings are qualitative or comparative and should be taken from the lower 0 to 100 scale on the meter.
- b. It should also be noted that when taking readings on materials of a thickness of less than 25mm, the substrate of these materials may have an effect on the readings. Use Scale 2 Shallow Depth to eliminate the effect of the substrate on the readings.
- c. The moisture profile of a hull can be determined by placing your Skipper 5 along the surface where it will read through most thinly applied paints and coatings.
- d. The rubber electrodes of the Skipper 5 do not scratch the protective coverings of the hull.
- e. The Skipper 5 will help identify the different levels of moisture even if not apparent on the surface.
- f. Always consult coating or treatment manufacturers recommendations for acceptably dry levels.

LIMITATIONS

The Skipper 5 will not detect or measure moisture through any electrically conductive materials or coat-ings including fuel tanks or through bulk heads or wet surfaces.

WARRANTY

Tramex warrants that this instrument will be free from defects and faulty workmanship for a period of one year from date of first purchase. If a fault develops during the warranty period, Tramex will, at its absolute discretion, either repair the defective product without charge for the parts and labour, or will provide a replacement in exchange for the defective product returned to Tramex Ltd.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inad-equate maintenance and care.

In no event shall Tramex, its agents or distributors be liable to the customer or any other person, company or organisation for any special, indirect, or consequential loss or damage of any type whatsoever (including, with-out limitation, loss of business, revenue, profits, data, savings or goodwill), whether occasioned by the act, breach, omission, default, or negligence of Tramex

Ltd., whether or not foreseeable, arising howsoever out of or in connection with the sale of this product including arising out of breach of contract, tort, mis-representation or arising from statute or indemnity.

Without prejudice to the above, all other warranties, representations and conditions whether made orally or implied by circumstances, custom, contract, equity, statute or common law are hereby excluded, including all terms implied by Section 13, 14 and 15 of the Sale of Goods Act 1893, and Sale of Goods and Supply of Services Act 1980.

WARRANTY CLAIMS

A defective product should be returned shipping pre paid, with full description of defect to your supplier or to Tramex at address shown on the back of this guide.

PRODUCT DEVELOPMENT

It is the policy of Tramex to continually improve and update all its products. We therefore reserve the right to alter the specification or design of this instrument without prior notice.

SAFETY

This User Guide does not purport to address the safety concerns, if any, associated with this instru-ment or its use. It is the responsibility of the user of this instrument to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.