TRAMEX

Innovation in moisture detection

user guide

SKIPPER PLUS

non-destructive
moisture meter for
the marine industry

ABQINDUSTRIAL
PRECISION. RELIABILITY. QUALITY.

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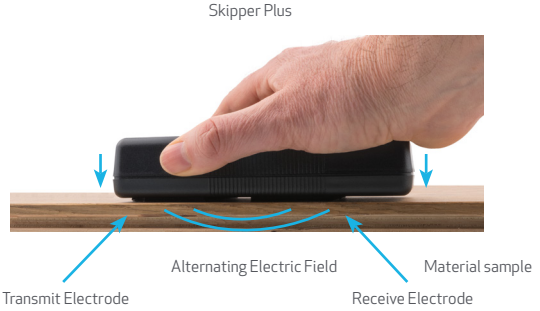
INTRODUCTION

Thank you for selecting the Skipper Plus from Tramex. The Skipper Plus 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 Plus meter features three Ranges enabling you to select the correct range for the material and environment in which you are working. Use Range 1 to give you the percentage moisture content in Wood. Use Range 2 to indicate on the comparative scale, moisture in GRP and use Range 3 to indicate Surface Moisture on the comparative scale.

The instrument operates on the principle that the electrical impedance of a material varies with its moisture content. To measure / detect moisture, the two 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. 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.



As there is a wide variation in the nominal electrical impedance of different material types, the instrument is provided with three selectable ranges which are optimized for testing (1) Hardwood, (2) GRP and (3) Surface Moisture.

Diagnosis

Your Skipper Plus 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 Plus is also essential in monitoring drying out of hulls and other boat components prior to remedial treatment.

Osmosis in GRP

Use Range 2 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 Plus 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 Plus 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 Range 1 for Wooden boats. Moisture readings for wood should be read from the top scale of the meter marked %H20 Wood, 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 Plus is a useful preventative maintainance 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 Plus 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 Plus . 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 Plus is calibrated. See notes on Specific Gravity and reading adjustment on page 15.

INSTRUMENT FEATURES

Your Skipper Plus employs advanced analog and digital technology to enable the incorporation of many useful features, which greatly extend the capability of the instrument.

- Three simple pushbutton controls, ON, RANGE and HOLD.
- Non-destructive moisture readings taken in Wood from 5% to 30% are displayed on a clear, easy to read moving coil meter with a linear scale.
- Comparative readings between 0 and 100 can be taken in GRP.
- Audio signal sounds when meter indicates high reading and can be disabled if required.
- The HOLD button freezes moving coil meter, which facilitates readings taken out-of-sight.
- If HOLD was selected prior to supply timeout, the held reading is restored next time the meter is powered on.
- Automatic supply timeout (2 minutes) conserves battery life.
- Supply timeout is automatically extended if a change in the meter reading is detected or if any button is pressed.

- Bleep warning on instrument sounder 10 seconds prior to end of supply timeout period.
- Last used RANGE is memorized at supply timeout and automatically selected next time ON button is pressed.
- Three LEDs indicate selected range, indicate if HOLD selected and provide warning of battery nearing end of useful life.

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 Indicators.
3 = Scale Select button.
4 = Power ON/OFF button.
5 = Hold button.

1. Press the ON/OFF button to power up. The LED for the last used scale will light.

[Note – If the battery voltage is getting low, the three LEDs will flash sequentially for a short period. The instrument will continue to operate for some time but it is recommended that the PP3 (9 volt) battery be changed as soon as convenient.]

2. To change range, press/release the RANGE button until the LED opposite the required range lights.
3. Press and hold your Skipper Plus directly on the material being tested, ensuring both conductive rubber electrodes are fully in contact with the surface. (Partial contact will give reduced readings).
4. Select RANGE 1 when measuring moisture content in Wood and read the upper line (% H2O Wood) of the meter dial which is marked from 5% to 30%. The audio signal will sound when meter indicates a reading above mid scale.
5. Select RANGE 2 when surveying or inspecting a GRP hull or fitting and read the bottom comparative scale, which is marked from 0 to 100.
6. Select RANGE 3 when testing for elevated near surface moisture in GRP and Wood materials and read the bottom comparative scale, which is marked from 0 to 100.

7. To turn audio signal on or off, press HOLD/AUDIO button twice in quick succession.
8. The instrument will automatically power-off after ten 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 ten minutes.
9. To hold readings press the HOLD/AUDIO button once. While on Hold, the LED for the selected range will flash. This facility is extremely useful if readings are being taken in areas where it is difficult to see the instrument dial. To release HOLD/AUDIO, press the HOLD/AUDIO button again.

WORKING WITH YOUR SKIPPER PLUS

RANGE 1 - Testing Hardwood

a. When testing Wood, power-on, select Range 1 and press the rubber electrodes directly to the surface. Read the moisture content percentage from the top line of the analog dial which is marked from 5% to 30%. The Skipper Plus has been calibrated for a hardwood specific gravity of 0.6 S.G.

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 15 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 to12% 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 Plus 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 nonconductive 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 Plus 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.

How to use the Wood SG Tables

When testing wood, which does not have an SG of 0.60, the meter reading can be adjusted by referring to the tables 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 0.8 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

RANGE 2 - Testing Glass Reinforced Plastic (G.R.P.)

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 Plus 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 Plus can identify areas where osmosis, or the potential for osmosis development, is present when used on RANGE 2. Readings should be taken from the comparative scale (0 to 100) on the meter dial.

RANGE 3 - Testing for Elevated Surface Moisture

The Skipper Plus can be used in RANGE 3 to detect moisture on or just below the surface. This can be of great benefit in verifying if high moisture readings on Range 1 or 2 are as a result of deep set moisture, surface moisture or conductive coatings.

Range 3 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 Range , and readings should be taken from the 0 to 100 comparative scale on the meter dial.

NOTES

a. Your Skipper Plus is calibrated to give %H2O moisture readings when set on Range 1 in Hardwood of 0.6 S.G. This reading is displayed on the upper scale of the meter and is marked %H2O 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 affect on the readings.

c. The moisture profile of a hull can be determined by sliding your Skipper Plus across the surface where it will read through most thinly applied paints and coatings.

d. The rubber electrodes of the Skipper Plus do not scratch the protective coverings of the hull.

e. The Skipper Plus 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.

g. The Skipper Plus will not detect or measure moisture through any electrically conductive materials or coatings 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 inadequate 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, without 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 instrument 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.