Model 920
Moisture Tester

Shore Measuring Systems

T.W. BRACKETT & ASSOCIATES

OPERATION MANUAL

SERIAL NUMBER

At Shore Measuring Systems, "*we SERVICE what we sell*". To help us better serve your operation and service needs, record the serial number of your tester in the space provided below so this information is readily available when you need to contact us.

Serial Number:

REGISTRATION CARD

When you receive your equipment, please complete and return the registration card below. Shore Measuring Systems maintains a file of all Model 920 Moisture Testers sold based on their serial numbers. With your help, your moisture tester will be recognized by the buyer's name and location.

Registration Card

Model 920 Moisture Tester

Serial Number: _____

Buyer's Name: _____

Address: _____

City: _____ State: _____

Zip Code: _____

Telephone Number: _____

Date of Purchase: ___/___/___

Model 920 Moisture Tester

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Model 920 Moisture Tester

SPECIFICATIONS

GENERAL INFORMATION

Product Overview

The Model 920 is a precision moisture meter that provides quick and accurate moisture results. The results are displayed automatically without the need for moisture or temperature conversion tables. When used within the specified operating limits, the Model 920 will produce moisture results that are as accurate as commercial moisture meters costing thousands of dollars more. The Model 920 has been designed to meet or exceed NIST handbook 44 specifications for grain moisture meter accuracy. These are the same accuracy specifications that commercial "Legal for Trade" moisture meters must meet. Some of the unique features that allow the Model 920 to achieve this level of accuracy are listed below.

Proven Design

The grain test cell and sample dump cell were designed to replicate the cells found in the moisture meter that was used for more than 30 years to perform official grain inspections in the U.S. The calibrations for the Model 920 were derived from the calibrations for that meter and have over 30 years of calibration data behind them.

Representative Samples

Like commercial moisture meters, the Model 920 uses a large (typically 250 grams) test sample to assure that the sample is representative of the entire load. Most other transportable moisture meters use a much smaller sample; some use a sample as small as 20 grams. Studies have shown that the moisture level of corn kernels can vary by a couple of percent from one end of the ear to the other and vary by several percent from different areas of a field. Small test samples may not contain enough kernels to be representative.

Moisture as a Percentage by Weight

The Model 920 uses a pre-weighed sample. Moisture content is determined as a percentage by weight. It is difficult to determine moisture content accurately without knowing the weight. Some moisture meters use unreliable internal spring mechanisms to try to determine the weight of the sample; others just guess or ignore sample weight altogether.

Consistent Sample Loading

The Model 920 uses a proven grain dump cell design. The mechanical dump cell ensures that the grain will flow evenly and at a consistent rate into the grain test cell. The density or degree of packing of the grain in the grain test cell will affect moisture results. The mechanical loading method provided by the dump cell ensures that the grain will flow into the test cell in a consistent manner that will produce repeatable results. With some meters, the user just pours in the sample. It is very difficult to pour the grain evenly and at the same rate all the time, so repeatability and accuracy suffer.

Test Weight Compensation

The Model 920's unique grain cell design also compensates for variations in test weight. Test weight is a function of the kernel density. High test weight grains are more dense while low test weight grains are less dense. Grain density will affect moisture results. Most moisture meters will give higher moisture results on high test weight grains and lower results on low test weight grain so some type of compensation must be made for test weight variations. Other moisture meters just ignore test weight, so their accuracy falls off when the test weight varies.

Temperature Compensation

Grain calibrations are specified at some reference sample temperature. This reference temperature is usually 77°F or 25°C. When grain is warmer than the reference temperature, the moisture results will be higher than actual moisture. The results will be lower when the grain temperature is below the reference temperature. The temperature correction required for each grain varies and can range from about 0.05% per °F to 0.1% or more per °F. As you can see, a few degrees error in temperature measurement can cause a significant error in moisture results. Accurate temperature compensation becomes extremely important when the grain is very cold or very hot. The temperature correction for a sample of 21% moisture corn at 40°F can be as much as 2.6%!

In addition, when the temperature of the grain is more than a few degrees above or below the ambient temperature of the meter, a greater amount of time is required to allow the temperature sensor to accurately sense the grain temperature. The Model 920 uses a quick response, precision temperature sensor that will accurately measure sample temperature to within +/- 1 degree F. The Model 920 uses an intelligent process to determine when it should allow more time to accurately sense the temperature. Samples close in temperature to the meter will

test in only a few seconds, while extremely hot or cold samples will take up to 25 seconds to accurately measure the temperature. The Model 920's temperature compensation rates are among the best of any moisture meter on the market, including commercial grade meters.

Available Calibrations

The standard Model 920 includes calibrations for the most common grains. There are currently about 100 different calibrations for the Model 920 that are available by special request These calibrations include processed and unprocessed rice, edible beans & peas, coffee, peanuts, vegetable and grass seeds and many other commodities. Please contact Shore Measuring Systems for a complete list of available calibrations.

A Complete Moisture Testing Package

The Model 920 is available packaged in a sturdy protective carrying case along with a precision portable electronic scale for sample weighing. Both the Model 920 and the scale can be powered by internal batteries, or by the included external AC adapters. Power options for the 920 include power adapters that plug in automobile cigarette lighter sockets.

Note: *(1) Although the 920 meets NIST handbook 44 tolerances it may not be used in "Legal for Trade" applications in states that require NTEP certification for moisture meters.*

When ordering your Shore MODEL 920 grain unit, choose one of the following calibration groups that best matches the combination of commodities you plan to test:

Almonds, shelled
Almonds, ground hulls

Barley, 52 kg/hl and Over
Barley, Hulless
Barley, Light Weight,
    Less Than 52 kg/hl
Barley, Six-Rowed
Barley, Two-Rowed

Beans, Azuki
Beans, Black
Beans, Black (Turtle)
Beans, Chickpeas

Beans, Cranberry
Beans, Dark Red Kidney
Beans, Dutch Brown
Beans, Fababeans
Beans, Great Northern
Beans, Great Northern White
Beans, Kintoki
Beans, Light Red Kidney
Beans, Navy (Pea)
Beans, Otebo
Beans, Pea
Beans, Pink
Beans, Pinto

Beans, Small Red
Beans, White Kidney

Buckwheat

Canola and Rapeseed

Corn, High Moisture
Corn, Low Moisture

Grain Sorghum (Milo)

Lentils

Millet

Oats
Oats, Groats (Hulless Oats)
Oats, Light Weight,
   Less Than 48 kg/hl

Peanuts, Runner
Peanuts, Spanish
Peanuts, Virginia

Peas, Green and Yellow
Peas, Smooth Dry
Peas, Split, Green and Yellow

Popcorn, White
Popcorn, Yellow

Rice, Long Grain Brown
Rice, Long Grain Brown Parboiled
Rice, Long Grain Milled (White)
Rice, Long Grain Milled Parboiled
Rice, Long Grain Rough
Rice, Medium Grain Brown
Rice, Medium Grain Milled (White)
Rice, Medium Grain Milled Parboiled
Rice, Medium Grain Rough
Rice, Short Grain Brown
Rice, Short Grain Milled (White)
Rice, Short Grain Rough

Rye

Seed, Brown Mustard
Seed, Canary
Seed, Crambe
Seed, Flaxseed
Seed, Flaxseed - Solin and Linola
Seed, Hemp
Seed, Oriental Mustard
Seed, Safflower
Seed, Sunflower, Confectionery
Seed, Sunflower, Confectionery,
   Low Moisture
Seed, Sunflower, Edible
Seed, Sunflower, Oil
Seed, Sunflower, Oil, High Moisture
Seed, Yellow Mustard

Soybeans

Triticale

Wheat, Amber Durum
Wheat, Canada Prairie Spring,
   Red and White
Wheat, Canada Prairie Sprint,
   Red & White
Wheat, Durum
Wheat, Eastern Hard Red Winter
Wheat, Eastern Red
Wheat, Eastern Red Spring
Wheat, Eastern Soft Red Winter
Wheat, Eastern White Winter
Wheat, Extra Strong Red Spring
Wheat, Hard Red Spring
Wheat, Hard Red Spring,
   66 kg/hl and Over
Wheat, Hard Red Spring,
   Light Weight, Less Than 66 kg/hl
Wheat, Hard Red Winter
Wheat, Hard White
Wheat, Hard White Spring
Wheat, Soft Red Winter
Wheat, Soft White
Wheat, Soft White Spring
Wheat, Western Winter

SHORE MODEL 920 MOISTURE METER
OPERATING INSTRUCTIONS

1. Turn on meter. The 920 will perform an internal self-test while displaying model, serial number and software version.

2. The 1st grain calibration will be displayed. Use **UP** or **DOWN** arrows to display other available grains.

3. When the desired grain is displayed, press **TEST**. The 920 will display **"Wait"** while it performs internal calibration for that grain.

    While performing the internal calibration, the 920 will check to make sure that the grain cell does not already contain a sample. If this is the case, the operator will be prompted to **"Empty the cell and press a key."**

4. The display will then show the required sample size and prompt the operator to load and test the sample.

5. Weigh the required amount of the grain and put it into the top chamber of the dump cell.

6. Place the dump cell containing the sample onto the grain cell.

7. Press the dump cell knob to load the sample, then remove the dump cell and press **TEST**.

    (When you remove the dump cell, flip it over and it will automatically reset and be ready for the next sample.)

    The 920 will display **"Wait"** while the sample is being tested and then display the sample temperature, followed by the moisture. The 920 will delay from 3 to 25 seconds before displaying results. (The length of the delay is dependent on the grain temperature relative to the ambient temperature. The closer the grain temperature to ambient, the shorter the delay.)

8. Dump the sample out of the grain test cell and press **TEST** to perform another test on the same grain or select a different grain. (While the moisture results are being displayed, the **UP** or **DOWN ARROW** keys can be used to switch between temperature and moisture.)

9. If viewing the display in very dim light, pressing the button located towards the right rear corner of the console will turn on the display backlight to brighten the display.

Special Grain Conditions

1. When testing high moisture corn, the large sticky kernels will sometimes lodge between the cell center post cone and the cell tube. If this occurs, just flick them down into the cell before pressing the **TEST** key. The level of the grain in the test cell should be below the bottom of the white cone for an accurate test.

2. Like all moisture meters, the Model 920 grain calibrations are based on good quality, clean grain samples. Quality factors such as moldy grain, excessive dirt or foreign materials may affect accuracy.

TESTING HOT GRAIN

To achieve accurate moisture results, moisture meters must be able to sense the sample temperature and apply a temperature correction. The Model 920's sample temperature sensor will provide very accurate compensation for the grain temperatures up to 110°F and will also provide reasonably good results up to 160°F, if samples are of uniform temperature. When the Model 920 senses that the sample temperature is above 110 degrees, the moisture display will contain the word **"Hot"** to alert the user to potential problems with the results, as outlined below. When **"Hot"** is displayed, we suggest that you test the sample 3 times and take an average of the results.

There are several problems that can be encountered when testing hot grain from a dryer.

*   The sample may not be a uniform temperature throughout (some kernels hotter than others).

*   The temperature of the individual kernels will not be the same throughout the kernel.

*   The temperature of the grain will be changing rapidly.

*   The hot grain is still expelling moisture. Since there is now no air movement over the grain, a film of water will form on the exterior of the grain kernels. Surface moisture can cause moisture meters to give erroneous results. (If many kernels stick to the sides and bottom of the grain cell when you dump the grain out, then you probably have excessive surface moisture.)

Since the amount of temperature compensation required is related to the moisture level of the grain, high temperatures in higher moisture grain will cause more problems than in dry grain below 16%. (We are compensating mainly for the temperature of the water in the grain.) Typically, hot grain from the dryer that tests

18% to 25% will test from 0.5% to 1.5% wetter if it is put in a sealed container and allowed to stabilize for an hour or two. Grain below 18% will show a smaller moisture gain.

Two things happen when the hot grain is allowed to stabilize in a sealed container.

1. The temperature throughout the sample and individual kernels becomes uniform.

2. Moisture distribution levels throughout the sample and kernels become more uniform.

These are the types of grain conditions that all moisture meter calibrations are based upon and therefore, these conditions result in the most accurate test results. This also more closely duplicates the conditions achieved by "steeping" the grain before binning.

If time allows, it is always best to let the hot grain sample cool and stabilize for an hour or two before testing. At the very minimum, the sample should be allowed to stabilize for at least 5 minutes, then mixed well before removing a portion for testing. This sample should be tested 3 times and averaged. If it is not possible to completely stabilize the sample, then a manual correction to the moisture result may be required to accurately determine the "real final moisture" of the sample. The amount of correction needed may have to be determined by experimentation.

If you have questions, contact Shore Measuring Systems at (800) 837-0863 or 765-769-3000.

MOISTURE TESTING ACCURACY

When discussing the accuracy of moisture tests, we must first define a reference for comparison. There are two categories of references. These are the **"Primary"** and **"Secondary"** references.

The Primary reference standard is the air oven. In the air oven method, samples of grain to be tested are ground to a specific particle size, precisely weighed and then they are heated in the ovens at specified temperatures for specified periods. The samples are then re-weighed and the original moisture level computed by using the weight loss in drying. The procedures for performing air oven tests on various types of grain are specified in the **USDA "Moisture Handbook."** The air oven test takes from one hour to more than 72 hours depending on the type of grain and moisture levels. Since the **"Primary"** method requires a laboratory, lots of specialized equipment and a lot of time, it is not suitable for everyday moisture testing.

The **"Secondary"** reference is usually a moisture meter that has been calibrated to closely match the air oven. This secondary standard is then used to verify the calibration of other moisture meters. The main problem that occurs with this secondary method is that various manufacturers' moisture meters, including the secondary standard, may react differently to new strains and hybrids and differing grain quality. This is the reason that all moisture meter calibrations should be referenced to the primary standard air oven.

It must also be understood that hundreds and sometimes thousands of grain samples from several crop years are used to develop grain calibrations. The resulting calibrations are "averages" of all the samples tested and some samples that lie at the extremes of the averages may show a full percent or more of deviation from the "average."

The Model 920 grain calibrations are referenced to the primary standard air oven and all accuracy specifications for the Model 920 are in reference to the air oven results. Also bear in mind that as previously stated, grain calibrations are based upon averages of many samples and occasionally you may test a sample that deviates by a large amount from the average. The maximum accuracy tolerance specifications for the Model 920 are the same as those specified in NIST handbook 44. These are maximum tolerances and the 920 typically will be within ½ of the maximum tolerance when compared to the standard air oven method.

Specifications for grain moisture meters used in "Legal For Trade" applications in the U.S. are published by the National Institute of Standards and Technology (NIST) in NIST handbook 44. The HB 44 tolerances for grain moisture meters are as follows:

Type of Grain or Seed	Tolerance	Minimum Tolerance
Corn, Oats, Rice, Sorghum, Sunflower	0.05 of the percent moisture content	0.8 percent moisture content
All other cereal grains and oilseeds	0.04 of the percent moisture content	0.7 percent moisture content

Error Messages

The Model 920 tests its internal circuits whenever the power is switched on. The tests and error messages are listed on the following page.

POWER-ON TESTS

The following tests are performed when the 920 is first turned on.

Battery check: If the battery voltage becomes too low for reliable operation, the 920 will display **"Batt Low."** This message indicates that the battery should be replaced as soon as possible.

Grain cell check: If the grain cell is not empty when the 920 is turned on, the operator will be prompted to empty the cell and press a key. If this message occurs and there isn't any grain in the cell, then the 920 may require service.

Environmental check: The 920 environmental operating temperature is specified from +22° to +122°F. If the ambient temperature is outside these limits, a warning message will be displayed.

OTHER SELF-TESTS

Grain moisture & temperature limits: If the moisture level or temperature of the sample being tested is outside recommended limits a warning message will be displayed.

"Too Low!" or **"Too Hi!"** — Grain moisture too low or too high for selected calibration.

"Temp Lo!" or **"Temp Hi!"** — Grain temperature too low or too high.

MODEL 920 MOISTURE METER SPECIFICATIONS

Environmental operating temperature range: +22 to +122 deg F.

Measurement range: Varies with commodity. Typical moisture ranges are from 6% to 40%.

Sample temperature measurement range: +32 to +120 deg F. (Calibrations with extended sample temperature ranges up to 160°F are available.)

Sample test time: 5 to 30 seconds depending on sample temperature. Samples that are above 100 deg or below 40 deg will take a maximum of 30 seconds to allow for accurate temperature sensing. Samples close in temperature to the meter will take only a few seconds.

Accuracy: The Model 920 has been designed to meet or exceed NIST HB44 tolerances for grain moisture meters when used within specified limits.

Dimensions: Width: 5", Depth: 7", Height: 10.5", Weight 2.7 lbs

Display: Large 8-character alphanumeric LCD display with backlight for low-level ambient light conditions.

POWER REQUIREMENTS

The Model 920 can be powered from internal batteries, from the supplied external AC adapter, or from an optional automobile lighter adapter. The internal battery pack consists of 6 Alkaline AA batteries. Although the Model 920 will operate from standard carbon zinc batteries, alkaline batteries will provide much longer battery life. Alkaline batteries should provide 6 months to a year of intermittent use. Intermittent use is defined as less than 20 tests per week and infrequent usage of the display backlight.

In order to conserve batteries, the Model 920 will automatically shift to a low power mode after a few seconds of inactivity, but does not automatically shut off. Always turn off the power switch when the meter is not in use for long periods.

The batteries are automatically bypassed whenever the AC adapter is plugged in. If the Model 920 is to be used for an extended period where AC power is available, we suggest operating it from the AC adapter to extend battery life.

REPLACING BATTERIES

To replace the batteries, turn the Model 920 upside down and remove the battery cover. Replace the batteries observing correct polarity. If the meter is to be stored for an extended time or the batteries are not required, they should be removed. This will eliminate the possibility of damage from old leaky batteries.

COMPONENTS

Attached Grain Test Cell

Cell Center Post Cone

Dump Cell Assembly

On/Off Switch

Console

Dump Knob

Keypad Overlay

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