

Evaluation Report

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Preagro 35 Grain Moisture Tester

A Co-operative Program Between



PREAGRO 35 GRAIN MOISTURE TESTER

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RETAIL PRICE:

\$325.00 (March, 1986, f.o.b. Saskatoon, Sask.)

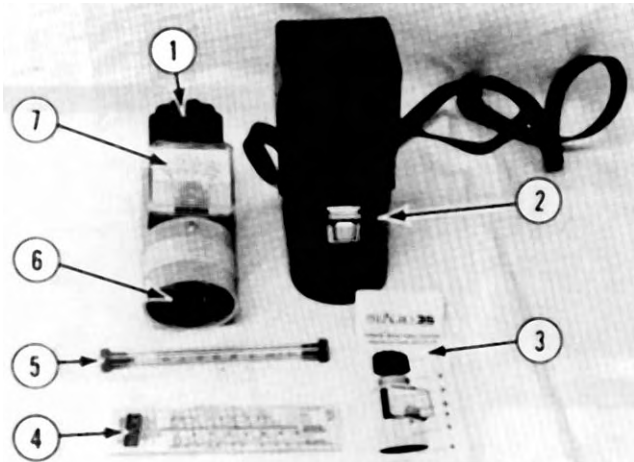


FIGURE 1. Preagro 35 Grain Moisture Tester: (1) Cap, (2) Carrying Case, (3) Operator's Manual, (4) Slide Rule, (5) Thermometer, (6) On-Off Zero Adjusting Knob, (7) Dial Reading.

SUMMARY

The accuracy of the Preagro 35 in wheat was good to very good between moisture contents of 11 to 19%. The overall performance was slightly reduced due to unsatisfactory repeatability. Accuracy in barley was only fair and varied considerably depending on the moisture content. Overall performance was reduced due to the scatter of results (only fair uncertainty) and unsatisfactory repeatability. Accuracy in canola (rapeseed) was very good from 7.5 to 10.5%. Uncertainty was excellent and repeatability was fair.

The meter was easy to operate and a moisture measurement could be made in less a minute. The meter was light, durable and easily transported for field use in its handy carrying case.

The operator's manual was well written, clear and informative.

As with most moisture meters, results depended on grain variety, the geographic location in which the grain was grown and many other variables. It is recommended that the user annually check a few samples against the meter used at his local elevator to determine a suitable correction factor.

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GENERAL DESCRIPTION

The Preagro 35 grain moisture tester determines moisture content using the capacitance principle. The principle is based on the change in the dielectric constant of the grain with changes in moisture content.

The dial on the meter indicates moisture content directly on three scales for wheat, barley and canola (rapeseed). A fourth scale on the meter face, calibrated in increments of one from one to fifty, can be used in conjunction with conversion charts to determine moisture contents of a variety of other grains.

Sample weighing is not required. A small handful of grain is

required to fill the sample chamber. Temperature compensation is performed automatically if the grain temperature is within 5°C of the temperature of the tester. A slide rule is provided for greater temperature differences.

The meter, thermometer, slide rule and operating instructions are carried in a leather carrying case.

The meter operates on a 9-volt transistor battery.

Detailed specifications are found in APPENDIX I while FIGURE 1 shows major components.

SCOPE OF TEST

The Preagro 35 meter was used to determine moisture contents of wheat, barley and canola (rapeseed). Meter readings were compared to moisture contents obtained using the American Association of Cereal Chemists oven method. This method is also used by the Canadian Grain Commission Research Laboratory. In addition, performance was compared to that of a PAMI reference moisture meter¹.

For each grain, artificially tempered samples (dry grain which was moistened in the laboratory and allowed to stabilize before moisture measurement) were used to determine meter performance.

The moisture content of each grain sample was measured five times with the meter. In total, over 160 measurements were made with the, Preagro 35 moisture meter. All results in the report are expressed on a percent wet-weight basis, consistent with common grain practice.

The meter was evaluated for ease of operation, quality of work and suitability of the operator's manual.

RESULTS AND DISCUSSION

EASE OF OPERATION

Moisture Measurement: The Preagro 35 was easy to operate. A moisture measurement could easily be completed in less than a minute. The sample size consisted of a small handful of grain to completely fill the sample chamber. No sample weighing was necessary and temperature compensation was automatic.

After compressing the grain sample by screwing down the cap, the moisture content was indicated directly by a dial on three scales for wheat, barley and canola. Scale divisions were to the nearest one percent, requiring estimation for intermediate values. The moisture content of other grains could be obtained using a fourth scale on the meter in conjunction with conversion charts supplied.

The meter was powered by a 9-volt transistor battery. The battery was readily obtainable and easily replaced. The on-off switch was not spring loaded and could be easily left on in error, resulting in premature battery failure. Field Use: The Preagro 35 was light, durable and easily transportable in a leather carrying case for convenient field use.

QUALITY OF WORK

Sample Size: Sample weighing was not required. Sample size consisted of filling the sample chamber with a small handful of grain. Since the sample chamber was small, the sample should be selected with care. Proper loading of the sample was necessary for accurate moisture content measurement. Proper loading, as outlined in the operator's manual, involved shaking the meter so one or two layers of grain were properly compacted around the electrode, before filling the sample chamber.

Temperature Compensation: Automatic temperature compensation was claimed if the grain sample was within 5°C of the temperature of the tester. A slide rule was provided for correction if the temperature difference was greater.

Measurement Range: The range of moisture content of greatest concern is between 12 and 20% for cereal grains and between 8 and 15% for canola. These ranges include dry, tough and damp stages.

The scale on the meter face indicated the Preagro 35 was capable of moisture content readings from 8 to in excess of 30% in wheat and barley and from 5 to in excess of 30% for canola.

The Preagro 35 was evaluated with samples ranging from 9 to

¹The PAMI reference moisture meter used for this series of tests was a Motomco model 919, similar to the moisture meter used in most prairie grain elevators. Accuracy results for the reference moisture meter are presented in APPENDIX II.

19% in wheat, 11 to 25% in barley and 7.5 to 15.5% in canola.

Meter Performance (Accuracy, Uncertainty and Repeatability): To assess meter performance, three factors; accuracy, uncertainty and repeatability, should be considered. Accuracy indicates how close the average meter reading is to true moisture content. Uncertainty is a measure of scatter over the range of moisture contents measured, or how close the readings follow a "best-fit" line. The shaded belts (APPENDIX II) can be used as a measure of meter uncertainty since they represent the region in which 95% of the test results can be expected to occur. A wide belt indicates a wide scatter and measurement uncertainty, whereas a narrow belt shows good meter certainty. Repeatability is a measure of how consistently a meter gives the same reading when the same grain sample is tested several times. If operator error or instrument error result in different readings with repeated measurements of the same sample, then the repeatability is poor.

The accuracy of the Preagro 35 in wheat was good to very good over a range of moisture contents from 11 to 19%. At 14.5% moisture content, the upper limit for dry wheat, the average meter reading was 0.4% high. This compared to a 0.4% low reading for the PAMI reference moisture meter. Although uncertainty of the Preagro 35 was excellent in wheat, repeatability was unsatisfactory. The unsatisfactory repeatability is an indication that several readings for the same sample should be averaged to obtain a representative moisture content. Poor repeatability was felt to be due to the variability of kernel compaction around the measuring electrode.

The accuracy of the Preagro in barley varied considerably with moisture content. At both high and low moisture contents, average readings were below true moisture content while in the mid range, moisture contents were above true moisture content. At 14.8% moisture content, the upper limit for dry barley, the average meter reading was 0.6% high. This compares to a reading of 0.5% low for the PAMI reference moisture meter. Results were scattered, resulting in only fair uncertainty. Repeatability, as in wheat, was unsatisfactory due to variability of kernel compaction around the measuring electrode.

The accuracy of the Preagro 35 in canola (rapeseed) was very good in a range of moisture contents from about 7.5 to 10.5%. At higher moisture contents accuracy remained good. At 10.5% moisture content, the upper limit for dry canola, the average meter reading was 0.3% high. This compares to a reading of 0.5% low for the PAMI reference moisture meter. Uncertainty in canola was excellent. Repeatability in canola was fair. This was a slight improvement over that in wheat and barley, indicating the smaller kernels compacted more uniformly around the measuring electrode.

Errors from Crop Variables: The dielectric properties of grain vary with grain variety, kernel size, geographic location, maturity, weathering, artificial or natural drying, tempering (whether or not a dry windrow was rewetted with rain) and other factors depending on the year the grain was harvested. The manufacturer's moisture scales are an attempt to accurately represent the average properties for one grain variety. It is difficult to accurately predict the dielectric properties of all varieties of grains grown in the prairies and to prepare an appropriate calibration chart. It is, therefore, recommended that the owner annually check the results of his moisture meter against the moisture meter used at his local elevator. Comparing only a few samples should give enough information to correct meter readings.

DURABILITY

The Preagro 35 moisture tester was durable and very well suited for field use. No problems were encountered throughout the evaluation and the battery did not require replacement.

OPERATOR'S MANUAL

The operator's manual was well written, clear and informative. It was folded to a size convenient to fit in the carrying case with the thermometer and a slide rule.

APPENDIX I SPECIFICATIONS

MODEL:	Preagro 35
SERIAL NUMBER:	76172
MANUFACTURER:	Oy Santasalo-Sohlberg AB Hankasuontie 4 S. F. 00390 Helsinki 39 Finland
ELECTRICAL POWER EQUIPMENT:	One 9 V transistor battery
OVERALL HEIGHT:	6.7 in (170 mm)
OVERALL WIDTH:	2.7 in (69 mm)
OVERALL LENGTH:	3.1 in (80 mm)
TOTAL WEIGHT:	1.6 lb (725 g)
PRINCIPLE OF OPERATION:	Resistance
SAMPLE SIZE:	1.3 fl oz (38 ml)

**APPENDIX II
STATISTICAL SIGNIFICANCE OF MOISTURE METER RESULTS**

The following data are presented to illustrate the statistical significance of the moisture meter results shown in FIGURES 2 to 5 below. This information is intended for use by those who may wish to check results in greater detail.

In the following table, M = the reading of the meter in percent moisture, wet basis, while T = the moisture content of the sample in percent moisture, wet basis, as determined by the American Association of Cereal Chemists oven method. Sample size refers to the number of grain samples used. Each meter sample represents the average of five meter readings on that sample.

Grain Type	Fig. No.	Regression	Correlation Coefficient	Standard Error	Sample Size	Sample Mean
PREAGRO 35						
Wheat, 9.5 to 19.5% m.c.	2	$M = 0.87T + 2.23$	1.00	0.28	8	14.64
Barley, 10.5 to 25% m.c.	3	$M = 0.97T + 1.06$	0.96	1.04	10	15.84
Canola, 7.5 to 15.5% m.c.	4	$M = 1.15T - 1.25$	1.00	0.26	7	10.89
PAMI REFERENCE METER						
Wheat, 9 - 25% m.c.	5	$M = 0.96T + 0.21$	1.00	0.11	10	15.03
Barley, 11 - 25% m.c.	5	$M = 1.00T - 0.57$	1.00	0.26	14	15.78
Canola, 6 - 15% m.c.	5	$M = 0.93T + 0.34$	1.00	0.16	10	10.87

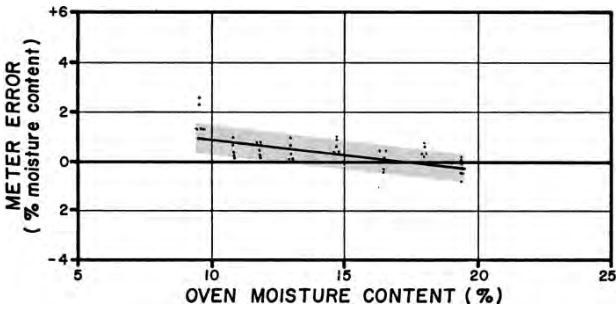


FIGURE 2. Accuracy of the Preagro 35 in Wheat.

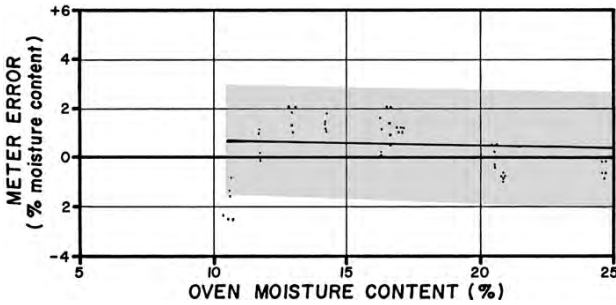


FIGURE 3. Accuracy of the Preagro 35 in Barley.

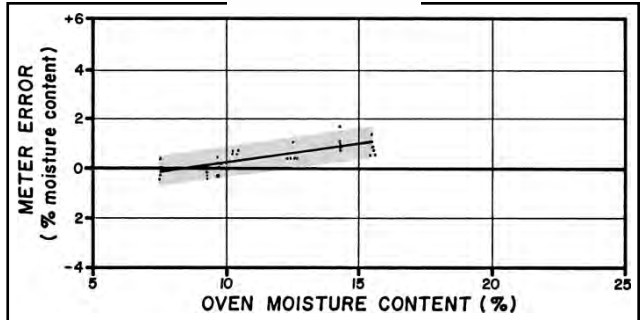


FIGURE 4. Accuracy of the Preagro 3.5 in Canola (Rapeseed).

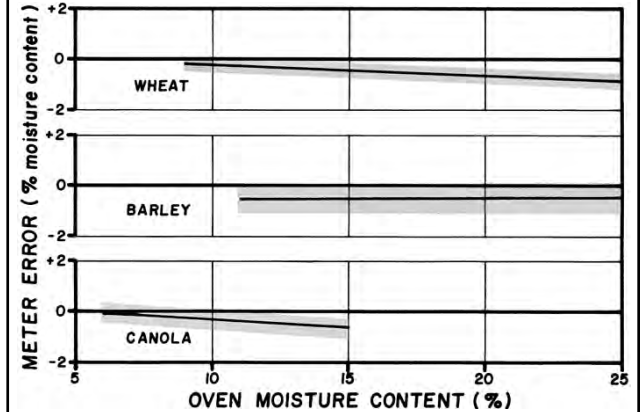


FIGURE 5. Accuracy of the PAMI Reference Moisture Meter in Wheat, Barley and Canola.

**APPENDIX III
MACHINE RATINGS**

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Very Good
Good	Fair
Poor	Unsatisfactory

**APPENDIX IV
CONVERSION TABLE**

1 millimetre (mm)	= 0.04 inches (in)
1 gram (g)	= 0.04 ounces (oz)
1 kilogram (kg)	= 2.2 pounds (lb)



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