

Evaluation Report

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Dani MK II Grain Moisture Meter

A Co-operative Program Between

DANI MK II GRAIN MOISTURE METER

MANUFACTURER:

Farmer Tronic Aps
Give, Denmark

DISTRIBUTOR:

Dani Farm Supply Limited
1202 - 104 Boyce Street
Red Deer, Alberta
T4R 1L4

RETAIL PRICE:

\$269.00 (March, 1986, f.o.b. Lethbridge, Alberta).

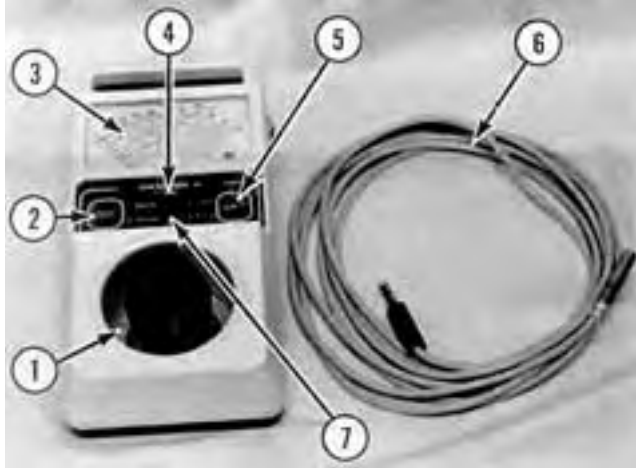


FIGURE 1. Dani Mk II Grain Moisture Meter: (1) Sample Chamber, (2) "Test" Switch, (3) Moisture and Temperature Scale Readings, (4) Meter Zero Adjust, (5) Battery Check Switch, (6) Temperature Probe and Cable (7) Meter Adjust.

SUMMARY

The accuracy of the Dani Mk II in wheat was very good between moisture contents of 9 to 16%. The overall performance was, however, reduced due to inaccuracy, uncertainty and reduced repeatability above 16%. Accuracy in barley was excellent over a narrow range of moisture contents from 11 to 15% but overall performance was reduced due to inaccuracy and the wide scatter (uncertainty) of results above 15% and reduced repeatability at higher moisture contents. Accuracy in canola (rapeseed) was good only at average moisture contents from 10 to 14%. At higher and lower moisture contents, the meter was inaccurate and uncertain.

The meter was easy to operate and a moisture measurement could be made in less than a minute. The meter was light and durable and was readily transportable for field use.

The operating instructions were clear and easy to understand. 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.

Accuracy of the temperature probe was very good.

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GENERAL DESCRIPTION

The Dani Mk II grain moisture meter determines moisture content using the capacitance principle. The principle is based on the change in the dielectric properties of grain with changes in moisture content.

The dial on the meter indicates moisture content directly on four scales for wheat, barley, oats and canola (rapeseed). A table of conversion scales for other crops is available.

Sample weighing is not required. Sample size consists of filling the sample chamber. A large handful of grain is required. Temperature correction is performed automatically.

The meter is self-contained in a sturdy plastic case complete with carrying handle. The test switches are spring loaded to avoid premature battery failure.

An external temperature probe complete with a 16.5 ft (5 m) cable for use in grain bins is also available. Temperature from 0 to 100°C is indicated directly on the meter.

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 Dani Mk II 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 375 measurements were made with the Dani Mk II 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.

The accuracy of the external temperature probe was evaluated by comparing temperature readings from 19° to 91°C to that of a mercury thermometer in a water bath.

RESULTS AND DISCUSSION

EASE OF OPERATION

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

When the test switch was depressed, the dial readout displayed moisture content on four scales, for barley, wheat, oats and canola. Scale divisions were to the nearest one percent, requiring estimation of intermediate values. The temperature scale was in increments of 2°C.

The meter remained "off" unless the spring loaded "test" button or the "battery test" button was depressed. This feature reduced risk of premature battery failure. No warm-up period was required.

The 9-volt transistor battery was replaced after 170 readings. The replacement battery lasted throughout the remainder of the evaluation period. The battery was readily obtainable and easily replaced by removing one screw.

Field Use: The Dani Mk II was light, durable and was self-contained in a sturdy plastic case complete with handle for convenient field use.

QUALITY OF WORK

Sample Size: Sample weighing was not required. Sample size consisted of filling the sample chamber until the grain was heaped over the central cone. Tapping the meter to compact the sample resulted in 0.4 to 1% increase in the moisture content readings. Care should be taken to avoid tapping the meter.

Temperature Compensation: The automatic temperature compensation was effective in the critical range near the upper limit for dry grain. At the extremes, pouring cold grain into a room temperature instrument could change the moisture content reading up to 1%. The user is cautioned to bring the meter and sample to room temperature for more accurate results.

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.

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.

The scales on the Dani Mk II meter indicated that it was capable of measuring moisture contents ranging from 10 to 24% in wheat and barley and from 7 to 14% in canola.

The Dani Mk II was evaluated with samples ranging from 9 to 25% in wheat, 10.5 to 25% in barley and 6 to 16.5% 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 Dani Mk II in wheat was very good over a range of moisture contents from 9 to 16%. At 14.5% moisture content, the upper limit for dry wheat, the average meter reading was 0.5% high. This compared to a 0.4% low reading for the PAMI reference moisture meter. Up to 16%, uncertainty was excellent and repeatability was very good. At higher moisture contents, accuracy, uncertainty and repeatability deteriorated.

The accuracy of the Dani Mk II in barley was excellent over a narrow range of moisture contents from 11 to 15%. At 14.8% moisture content, the upper limit for dry barley, the average meter reading was accurate (i.e. reading was 14.8%). This compares to a reading of 0.5% low for the PAMI reference moisture meter. At higher moisture contents, meter readings were inaccurate, uncertain and repeatability was poor.

The accuracy of the Dani Mk II in canola (rapeseed) was fair to good between moisture contents of 10 to 14%. At 10.5% moisture content, the upper limit for dry canola, the average meter reading was 0.5% high while the PAMI reference moisture meter read 0.3% low. Throughout this range, uncertainty was excellent and repeatability very good. At moisture contents above and below this range, the meter was inaccurate and uncertain.

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. Note that changing the meter adjustment screw to change meter readings will alter the scales for all three grains as well as the temperature scale.

DURABILITY

The Dani Mk II meter was durable and very well suited for field use. No problems were encountered with meter operation throughout the evaluation. More than 160 readings were taken before battery replacement was necessary.

OPERATOR’S MANUAL

The operating instructions were contained on a single sheet and were clear and complete.

APPENDIX I SPECIFICATIONS	
MODEL:	Dani Mk II
MANUFACTURER:	Farmer Tronic Aps Give, Denmark
ELECTRICAL POWER EQUIPMENT:	One 9 V transistor battery
OVERALL HEIGHT:	2.6 in (65 mm)
OVERALL WIDTH:	5.1 in (134 mm)
OVERALL LENGTH:	10.6 in (270 mm)
TOTAL WEIGHT:	21 oz (590 g)
PRINCIPLE OF OPERATION:	Capacitance
SAMPLE SIZE:	5.4 fl oz (152 mL) (one large handful)

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
DANI MK II						
Wheat, 9 to 16% m.c.	2	M = 1.07T + 0.51	1.00	0.12	6	13.71
Barley, 11 to 15% m.c.	3	M = 0.98T + 0.31	0.99	0.21	4	13.56
Canola, 10 to 14% m.c.	4	M = 1.20T - 1.60	1.00	0.14	4	11.86
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

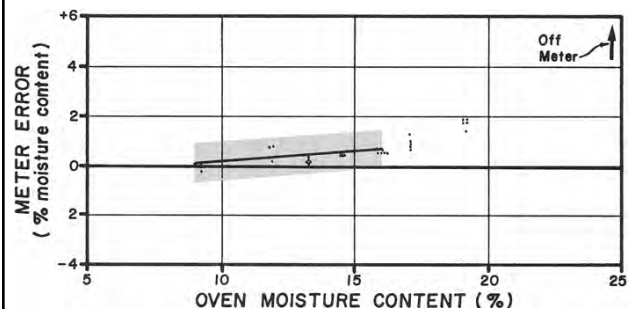


FIGURE 2. Accuracy of the Dani Mk I Meter in Wheat.

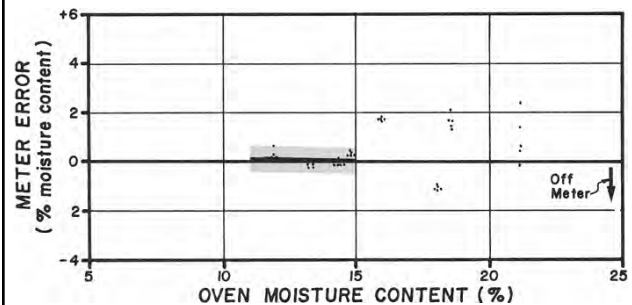


FIGURE 3. Accuracy of the Dani Mk II Meter in Barley.

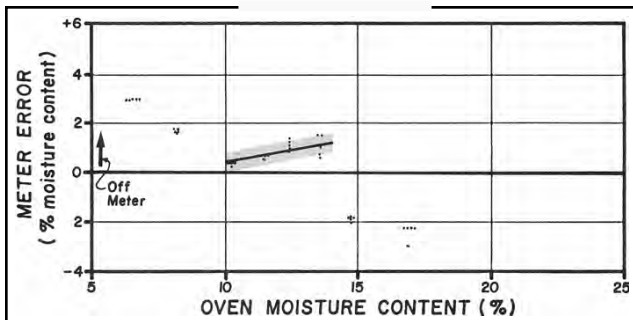


FIGURE 4. Accuracy of the Dani Mk II Meter in Canola (Rapeseed).

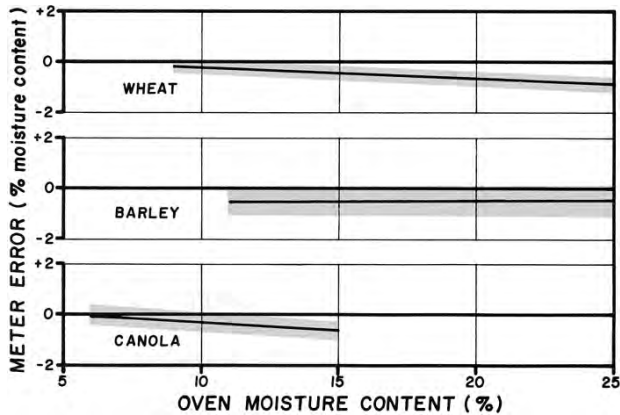


FIGURE 5. Accuracy of the PAMI Reference Moisture Meter in Wheat, Barley and Canola.

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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