PAMI

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Evaluation Report 32

RDS Mark 3 Combine Monitor

A Co-operative Program Between
ALBERTA FARM MACHINERY RESEARCH CENTRE
PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

RDS MARK 3 COMBINE MONITOR

MANUFACTURER:
RDS (Agricultural) Ltd.
Stroud Road, Nailsworth, Stroud
Glouscestershire, England
GL6 0BE

DISTRIBUTOR:
Dumarr Equipment
P.O. Box 950140
East Fourth Avenue
Regina, Saskatchewan
S4P 3B2

RETAIL PRICE:
$659.00 (July, 1978, f.o.b. Humboldt)

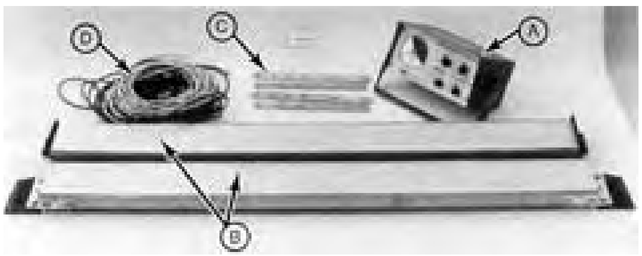

FIGURE 1. RDS Mark 3 Combine Monitor: (A) Control Box (B) Sensors (C) Mounting Hardware (D) Wiring Harness.

SUMMARY AND CONCLUSIONS

The RDS Mark 3 combine monitor, when properly installed to suit combine characteristics and when calibrated to suit crop conditions, was a very good indicator of changes in combine lossrate. It could effectively be used to aid the combine operator in maintaining the feedrate at an efficient level.

Although the RDS Mark 3 was effective in indicating changes in lossrate, its accuracy in indicating the actual grain lossrate was only fair. Monitor sensitivity was excellent in wheat and barley, and was good in rapeseed.

Meter visibility was very good during the day, but was poor at night because of inadequate meter illumination. The indicator needle was steady and moved smoothly, making it easy to read. The manufacturer's calibration procedure was functional and simple. Proper calibration to suit crop conditions was very important.

It took about seven man hours to install the RDS Mark 3 on a combine. As with most loss monitors, selecting proper sensor location was critical to the performance of the system.

The operator's manual and installation instructions were well illustrated, containing detailed information on sensor positioning, calibration and operation.

No failures or system malfunctions occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing better meter illumination for night use.

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Senior Engineer -- L. G. Smith
Project Engineer -- D. E. Gullacher

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Improved meter illumination is now standard.

GENERAL DESCRIPTION

The RDS Mark 3 combine monitor senses grain losses over the shoe and straw walkers of a combine and indicates changes in the rate of grain loss to the operator. It is designed to mount on most self-propelled or pull-type conventional combines.

Full width aluminum board-type sensors, which detect impacts from grain kernels, are attached at the rear of the straw walkers and shoe to intercept grain losses. Sensor signals are fed by cables to a control box mounted at the operator's station, where the rate of kernel impacts is measured and displayed.

The RDS Mark 3 may be powered by any 12V, negative ground electrical system. For positive ground systems, a separate battery, such as a dry cell, is required.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The RDS Mark 3 was used consecutively on two different combines for 341 hours while harvesting wheat, barley, and rapeseed. In addition to lossrate measurements in the field, various laboratory tests were conducted to aid evaluation.

It was evaluated for ease of installation, ease of operation and adjustment, quality of work, and suitability of the operator's manual.

RESULTS AND DISCUSSION

EASE OF INSTALLATION

Installation Time: It took about seven man hours to install the RDS Mark 3 on a combine using standard tools found in most farm shops. Installation instructions were clear, well illustrated, and easy to follow.

Sensor Installation: The RDS Mark 3 is supplied with two 1803 mm (71 in) long sensors (FIGURE 2) for mounting beneath the rear of the straw walkers and shoe. Sensors are cut to length with a hacksaw to suit the body width of the combine. The shoe sensor may be attached to the shoe or may be mounted in a stationary position behind the shoe, depending on combine configuration. The walker sensor may be mounted beneath the rear of open straw walkers or behind closed straw walkers. Templates are supplied to aid positioning of this sensor.

FIGURE 2. Sensors.

Although the instructions clearly outline various mounting locations and sufficient brackets and hardware are supplied for different mounting configurations, it is important to check the flow of losses over the shoe and straw walkers during operation to determine the optimum sensor location which permits the sensors to intercept the flow of losses. The walker sensor must also be checked after installation to ensure that straw is not hairpinning over the sensor. The addition of a straw deflector shield to prevent hairpinning on certain combines is outlined in the mounting instructions.

Control Box and Wiring Harness: The control box (FIGURE 3) is supplied with both U-bolt clamps and a pivoting mounting bracket to permit easy installation at a suitable location in a tractor or combine cab. Sufficient cable ties and clamps are supplied to route the wiring harness from the sensors to the control box. Optional cable extensions with quick-connections are available for use on pull-type combines.

EASE OF OPERATION AND ADJUSTMENT

Sensitivity Adjustment: Before combining, the sensitivity of the monitor must be tuned to the type of grain being harvested. This adjustment is simple, but requires two people. One person drops grain kernels onto a sensor while the other sets the sensitivity switch on the control box to the minimum level at which there is meter response. This adjustment is needed when changing crop types or whenever there is a significant change in conditions within one crop type. Proper sensitivity adjustment is important since it tunes the monitor to distinguish impacts of grain from impacts of straw for the specific crop being harvested.

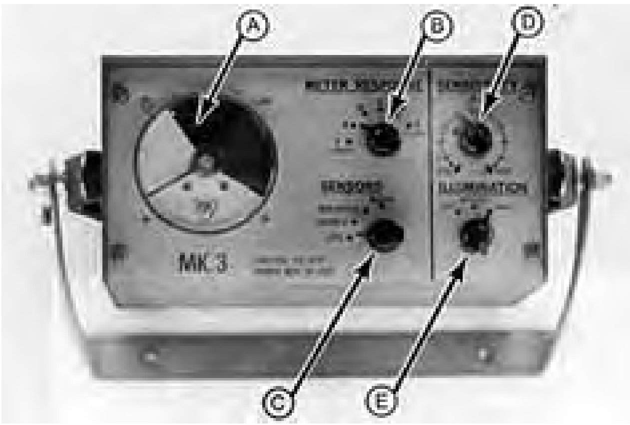

FIGURE 3. Control Box: (A) Loss Meter (B) Calibration Control (C) Sensor Selector and Power Switch (D) Sensitivity Control (E) Meter Illumination Control.

Calibration: Once the sensitivity has been adjusted, the monitor has to be calibrated to suit the loss characteristics of the combine in the specific crop being harvested. The following calibration procedure, which is a simplification of that given in the operator's manual, was functional and was easy to perform.

First, set the combine for best performance in the crop being harvested. Then, determine the maximum forward speed at which the combine can operate at an acceptable loss level. This is easiest if a second person checks for losses behind the combine. Since highest losses usually occur over the straw walkers and since losses are hard to detect after passing through the straw chopper or spreader, it is best to use a suitable container to catch a sample of the losses. Once the maximum acceptable forward speed has been determined, the calibration control on the control box is set to give a meter reading of one-half scale while combining at this speed.

Once the monitor has been calibrated, the meter reading is used to set the forward speed. If the meter rises above mid-point, losses are higher than desired and forward speed should be reduced. Conversely, if the meter reading drops below mid-point, the combine operation is inefficient and forward speed should be increased.

As with most loss monitors, recalibration is necessary whenever crop conditions change significantly. The operator should make occasional loss checks to determine if recalibration is required. Once an operator becomes familiar with the loss characteristics of his combine, monitor adjustment is easily made.

Meter Readability: The loss indicator on the control box was divided into three colored sectors to correspond to low, moderate, or excessive losses. The indicator was large and the black needle contrasted well with the colored sectors, making it easy to see during the day. Visibility was poor at night due to inadequate illumination. It is recommended that the manufacturer improve illumination.

Moderate fluctuations of combine lossrate occur which are beyond operator control because he cannot vary the feedrate quickly enough to counteract them. The loss monitor must be damped just enough so that these fluctuations do not appear and make the indicator difficult to read. Too much damping will cause the monitor to lag behind loss changes.

The RDS Mark 3 was moderately damped. It indicated average changes in lossrate and its indicator moved smoothly, making it easy to read.

QUALITY OF WORK ACCURACY

FIGURES 4 and 5 give comparisons of actual losses from a conventional combine to the losses as indicated by the RDS Mark 3 in fields of Neepawa wheat and Bonanza barley. Although the meter on the RDS Mark 3 is not calibrated to show the actual lossrate and the manufacturer indicates that the monitor is not intended to show the actual lossrate, these figures were prepared to illustrate the accuracy of the monitor in indicating combine performance. The position of the monitor curve in relation to the actual lossrate curve is determined by the calibration control.

FIGURES 4 and 5 represent monitor settings for which the monitor curve most closely approximates the actual loss curve, and further adjustment cannot improve the overall accuracy.

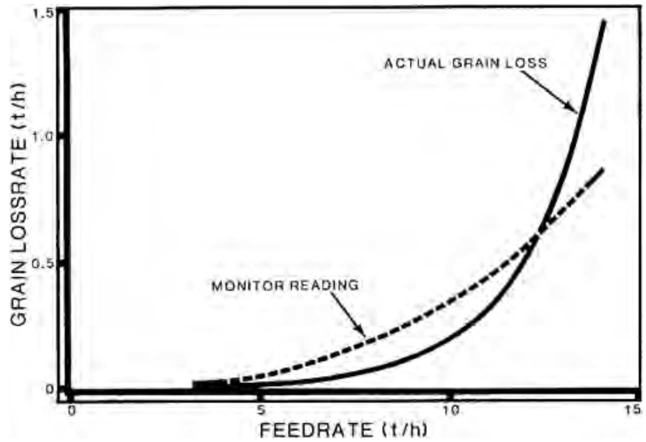

FIGURE 4. Comparison of Monitor Reading to Actual Combine Lossrate in a Field of Neepawa Wheat.

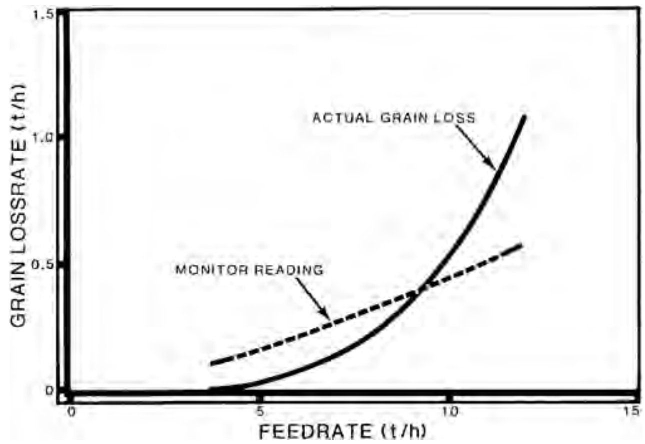

FIGURE 5. Comparison of Monitor Reading to Actual Combine Lossrate in a Field of Bonanza Barley.

From FIGURES 4 and 5 it can be seen, as the manufacturer indicates, that the monitor does not accurately show combine loss. As is common with most loss monitors, the monitor curve does not directly follow the actual loss curve and does not increase as rapidly as the actual loss curve at high feedrates. The FIGURES show, however, that when properly calibrated, the RDS Mark 3 can be effective in indicating changes in combine performance. The monitor effectively senses changes in the combine lossrate and a higher meter reading corresponds to higher losses. For example, in the crop shown in FIGURE 4, if the monitor is calibrated so that the meter mid-point reading corresponds to a feedrate of about 10 t/h, combine loss can be maintained at an acceptable level while operating the combine near peak efficiency if combine speed is adjusted to hold the meter at mid-point.

SOURCES OF ERROR

There are several sources of error, which affect the accuracy of a loss monitor. Because of these errors, most combine loss monitors cannot be accurate instruments and are not valid indicators of the actual amount of combine loss. However, with proper calibration, they can be effective in indicating changes in the lossrate, thereby, permitting the operator to continuously combine at a more efficient level.

Sensitivity: Sensors intercept the flow of material coming off the shoe and the straw walkers and are impacted by straw, chaff and grain. Sensitivity describes the ability of the monitor to distinguish between impacts of grain kernels and impacts of straw or chaff. Inaccuracy arises if the monitor fails to distinguish grain from straw and chaff in this way.

The RDS Mark 3 has a sensitivity control for tuning to the particular grain being harvested. When properly adjusted, sensitivity was excellent in wheat and barley and was good in rapeseed.

Sensor Positioning: For high accuracy, sensors must be positioned in the straw and chaff flows so that the meter readings obtained from the shoe and straw walker sensors are in the same proportion as the actual losses from the shoe and straw walkers. Since the loss from the shoe is discharged in a thinner blanket layer than from the straw walkers, more kernels per bushel of loss may strike the shoe sensor than the straw walker sensor. Since different combines have different straw and chaff flow patterns and since the sensor sample ratios change with crop type and condition, and combine feedrate, it is difficult for the manufacturer to predict, and compensate for these differences.

Sidehill combining may result in significant losses especially over the lower side of the shoe. Full width sensors, or two appropriately placed smaller sensors are necessary to sample losses of this nature. The RDS has full width sensors, which enable it to monitor losses in sidehill combining.

Crop and Combine Characteristics: Changes in crop conditions such as straw length and straw moisture content, and changes in the combine feedrate change the separating characteristics of the straw walkers. These changes affect the accuracy of the loss monitor.

OPERATOR'S MANUAL

The operator's manual and installation instructions were well illustrated, providing detailed information on possible loss trajectories, and suitable sensor locations.

The calibration procedure, given in the operator's manual, was simple and functional.

POWER REQUIREMENTS

The RDS Mark 3 drew a maximum current of 0.25 A and could be attached to any 12 volt electrical system with negative ground. For positive ground systems the manufacturer recommended use of a suitable 12V dry cell battery.

No problems occurred with electrical noise from the engine or electrical system on the two combines on which the monitor was installed.

DURABILITY RESULTS

The RDS Mark 3 combine monitor was operated in the field for 341 hours. The intent of the test was functional evaluation and an extended durability evaluation was not conducted. No durability problems occurred during functional testing.

APPENDIX I
SPECIFICATIONS

MAKE:	RDS Combine Monitor
MODEL:	Mark 3
SERIAL NUMBER:	DM7046
ELECTRICAL POWER REQUIREMENTS:	12V DC negative ground
CONTROL:	
-- size	245 x l23 x 171 mm (9.6 x 4.8 x 6.7 in)
-- weight	2.6 kg (5.7 lb)
-- display	80 mm (3.0 in) diameter meter with needle indicator
-- controls	sensor selector, sensitivity adjustment and calibration adjustment
SENSORS:	
-- number	2
-- type	aluminum board-type sounding board
-- size	1, 803 x 120 x 35 mm (71.0 x 4.7 x 1.4 in), full width of combine
-- weight	5.2 kg (11.4 lb)
WIRING HARNESS:	
-- power supply cable	1.8 m (6.0 ft)
-- sensor cables	2, 10.4 m (34.0 ft), coaxial
OPTIONS:	pull-type extensions with quick connectors

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

(a) excellent	(d) fair
(b) very good	(e) poor
(c) good	(f) unsatisfactory

APPENDIX III
METRIC UNITS

In keeping with the Canadian metric conversion program, this report has been prepared in SI units. For comparative purposes, the following conversions may be used:

1 metre (m) = 1000 millimetres (mm)	= 39.37 inches (in)
1 kilogram (kg)	= 2.2 pounds (lb)

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