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Evaluation Report 31

Bee Model 7410 Combine Loss Monitor

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

BEE MODEL 7410 COMBINE LOSS MONITOR

MANUFACTURED
AND
DISTRIBUTED BY:

Baker Engineering Enterprises Ltd.
Box 8340, Station F
Edmonton, Alberta
T6H 4W6

RETAIL PRICE:

$325.00 (July, 1978, f.o.b. Humboldt)

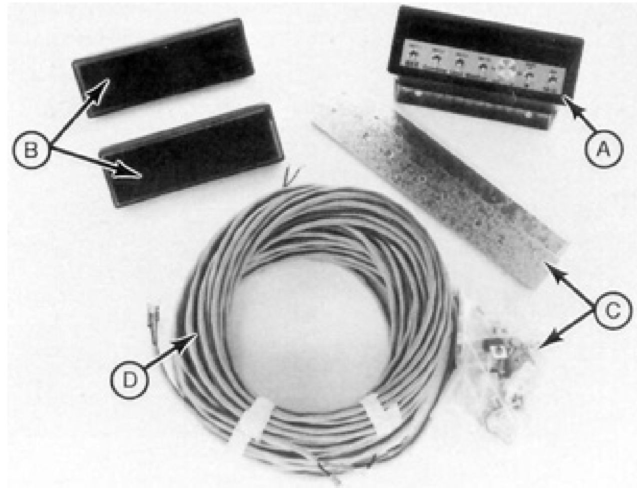

FIGURE 1. BEE Model 7410 Combine Loss Monitor: (A) Control Box (B) Sensors (C) Mounting Hardware (D) Wiring Harness.

SUMMARY AND CONCLUSIONS

The Bee Model 7410 combine loss monitor, when properly installed to suit combine characteristics and when calibrated to suit crop conditions, was a *very good* indicator of changes in combine loss rate. It could effectively be used to aid the combine operator in maintaining the feedrate at an efficient level.

Although the BEE 7410 was effective in indicating changes in lossrate, its accuracy in indicating the actual grain lossrate was only fair. Monitor sensitivity was *very good* in wheat and barley, and was *good* in rapeseed.

Indicator visibility was *fair* during the day and *very good* at night. The indicator, although only slightly damped, was quite stable, making it easy to read.

The manufacturer's calibration procedure was not highly functional. Instead, a simple calibration procedure was used. Proper calibration to suit crop conditions was very important.

It took about four man hours to install the BEE 7410 on a combine. As with most loss monitors, proper sensor positioning was critical to the performance of the system.

The operator's manual was clearly written and well illustrated and contained detailed information on the installation and operation of the loss monitor.

One sensor failure occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the calibration procedure to make it more functional.

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

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The instruction manual has been revised to simplify the calibration procedure.

MANUFACTURER'S ADDITIONAL COMMENTS

In July, 1978 we introduced a revised combine loss monitor model 7710A which has improvements in sensitivity for oil seed crops, ease of calibration, readability of the display, wiring harness, and general reliability.

GENERAL DISCRIPTION

The BEE Model 7410 combine loss 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.

Small pad-type sensors, which detect impacts from grain kernels, are attached beneath 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 BEE 7410 may be powered by any 12V, positive or negative ground electrical system.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The BEE 7410 was used consecutively on three different combines for 277 hours while harvesting wheat, barley, and rapeseed. In addition to loss rate 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 four man hours to install the BEE 7410 on a combine using standard tools found in most farm shops. The installation instructions were clear, well illustrated and easy to follow.

Sensor Installation: The BEE 7410 is supplied with two 156 x 56 mm (6.1 x 2.2 in) pad-type sensors (FIGURE 2) for mounting at the rear of the straw walkers and shoe.

The shoe sensor may be mounted behind the shoe or beneath the shoe behind the tailings auger. It was found that a sensor, mounted behind the shoe, gave more positive sampling of losses than did the one beneath the shoe.

The walker sensor may be mounted in the bottom of a closed straw walker or on the grain pan beneath an open straw walker. It was found that a sensor could also be mounted behind the straw walker, however, flying objects from the straw chopper could damage this sensor.

As is common with most loss monitors, 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.

Control Box and Wiring Harness: The control box (FIGURE 3) is supplied with 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. An optional cable extension and coupler is available for use on pull-type combines.

EASE OF OPERATION AND ADJUSTMENT

Sensitivity Adjustment: Before combining, the sensitivity of the monitor must be set. This is easily done by selecting either the "large kernel" or "small kernel" position of a switch to correspond to the type of grain being harvested. Proper sensitivity adjustment is important since it sets the monitor to distinguish impacts of grain from impacts of straw for the specific crop being harvested.

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 manufacturer's calibration procedure was not highly functional since it depended on the accuracy of the monitor to determine the rated capacity of the combine. The following simple calibration was used instead.

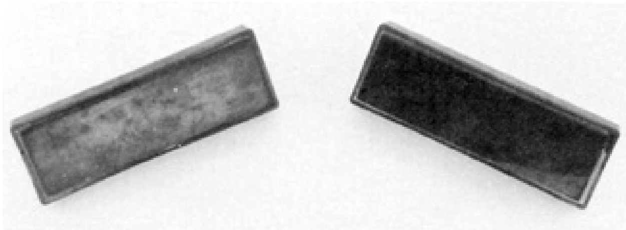

FIGURE 2. Sensors.

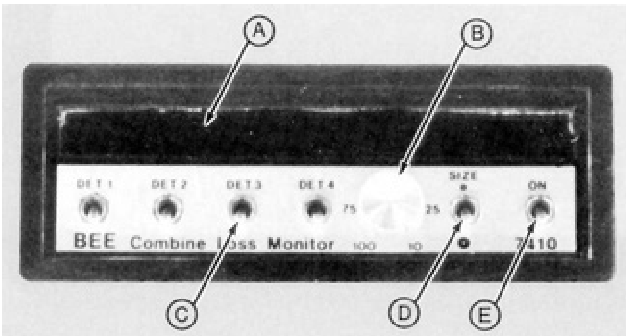

FIGURE 3. Control Box: (A) Loss Indicator (B) Calibration Control (C) Sensor Selectors (D) Sensitivity Control (E) Power Switch.

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-third 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 one-third scale, losses are higher than desired and forward speed should be reduced. Conversely, if the meter reading drops below one-third scale, 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 consisted of a row of small red lights. An increase in the number lit indicated an increase in grain loss. Visibility of this indicator was very good at night, however, bright sunlight reduced visibility during the day.

A warning alarm that sounds when losses are excessive can be obtained from the manufacturer. When the alarm is used the indicator does not have to be watched continually.

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 changes.

The indicator, although only slightly damped, was quite stable and easy to read.

QUALITY OF WORK

ACCURACY

FIGURE 4 is a comparison of actual losses from a conventional combine to the losses as indicated by. the BEE 7410 in a field of Bonanza barley. The graph was 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

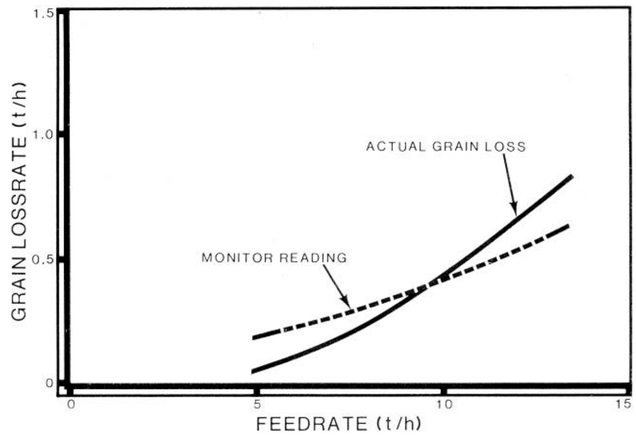

FIGURE 4. Comparison of Monitor Reading to Actual Combine Lossrate in a Field of Bonanza Barley.

determined by the calibration control. FIGURE 4 represents settings for which the monitor curve most closely approximates the actual loss curve, and further adjustment cannot improve the overall accuracy.

From FIGURE 4 it can be seen, as is common with most loss monitors, that 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 FIGURE shows that when properly calibrated, the BEE 7410 can be effective in indicating changes in combine performace. 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 a one-third scale reading corresponds to a feedrate of about 6 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 indicator constant.

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 very 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.

The BEE 7410 has a sensitivity switch for setting to the grain type being harvested. When properly set, sensitivity was very good in wheat and barley and 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 BEE 7410 has only one small sensor for the shoe but provision is made for the installation of two additional sensors.

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

OPERATOR'S MANUAL

The operator's manual was clearly written and well illustrated. Detailed installation instructions were provided which contained various sensor mounting suggestions. Instructions for use of the loss monitor were detailed and clear.

The calibration procedure, given in the operator's manual, was not highly functional. However the loss monitor could be easily calibrated using the procedure discussed under "EASE OF OPERATION AND ADJUSTMENT". It is recommended that the manufacturer modify the calibration procedure to make it more functional.

POWER REQUIREMENTS

The BEE 7410 drew a maximum current of 0.33A and could be attached to any 12 volt electrical system with positive or negative ground.

No problems occurred with electrical noise from the combine electrical system.

DURABILITY RESULTS

The BEE Model 7410 combine loss monitor was operated in the field for 277 hours. The intent of the test was functional evaluation and an extended durability evaluation was not conducted. One sensor failure occurred during the test.

APPENDIX I

SPECIFICATIONS

MAKE:	BEE Combine Loss Monitor
MODEL:	7410
SERIAL NUMBER:	0120BEE
ELECTRICAL POWER REQUIREMENTS:	12V DC positive or negative ground
CONTROL BOX:	
-- size	152x57x117 mm (6.0x2.3x4.3 in)
-- weight	0.43 kg (0.95 lb)
-- display	LED series
-- controls	sensor selectors, sensitivity adjustment, and calibration adjustment.
SENSORS:	
-- number	2
-- type	plastic pad-type sounding board
~ size	156x56x19 mm (6.1x2.2x0.75 in)
-- weight	0.08 kg (0.17 lb)
WIRING HARNESS:	
-- power supply cable	2.8 m (9.3 ft)
-- sensor cables	2, 4.4 m (14.3 ft), 2 conductor vinyl clad
OPTIONS:	Pull-type combine wiring extension and connector, extra sensors, and audible alarm

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

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

APPENDIX III

METRIC UNITS

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

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

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