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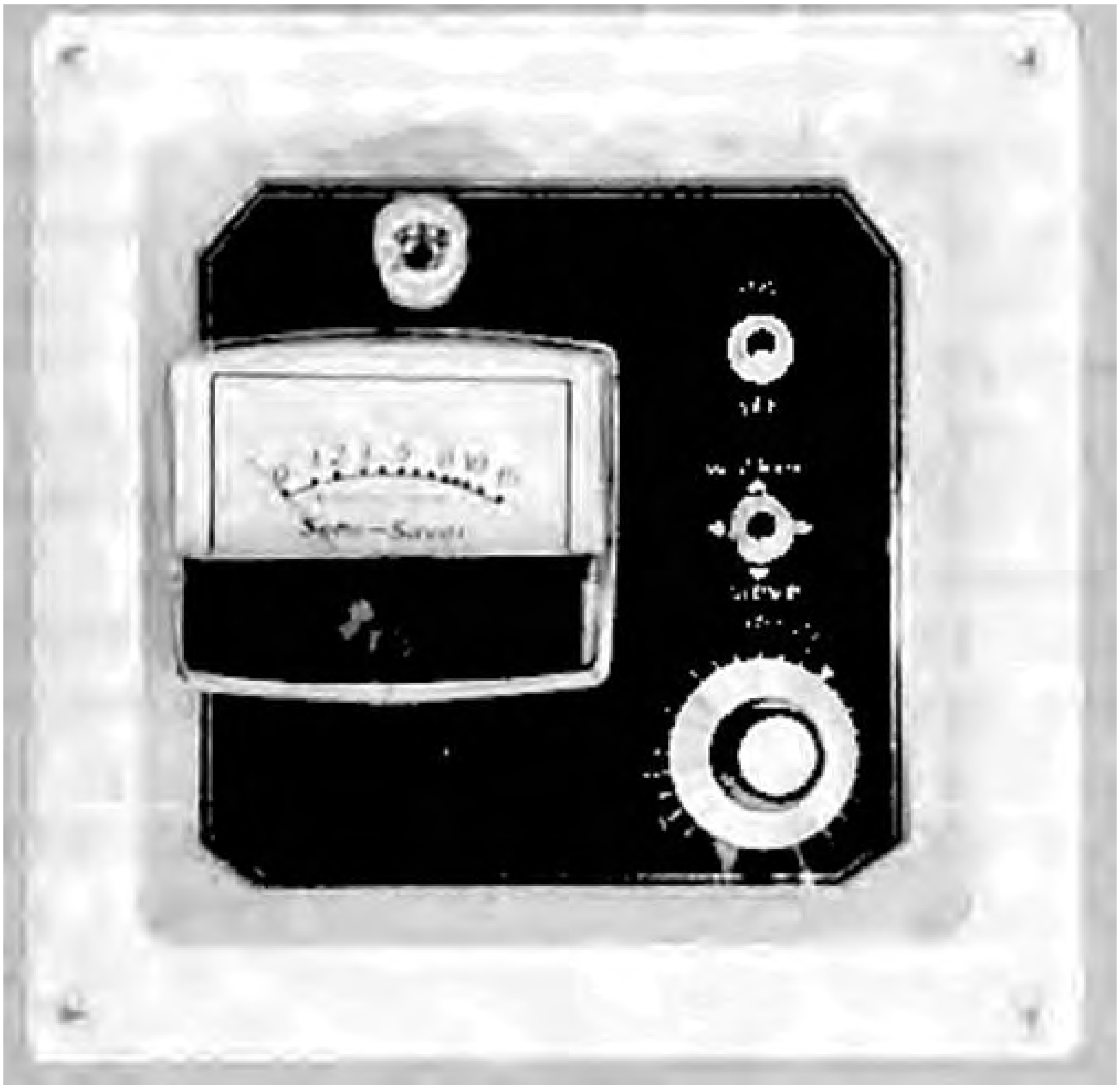

Senstek Sens-Saver SS2 Grain Loss Monitor

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

SENSTEK SENS-SAVER SS2 GRAIN LOSS MONITOR

MANUFACTURED AND DISTRIBUTED BY:

Senstek Ltd.
125-105 Street
Saskatoon, Saskatchewan
S7N 1Z2

RETAIL PRICE:

$339.00 (July, 1978, f.o.b. Humboldt)

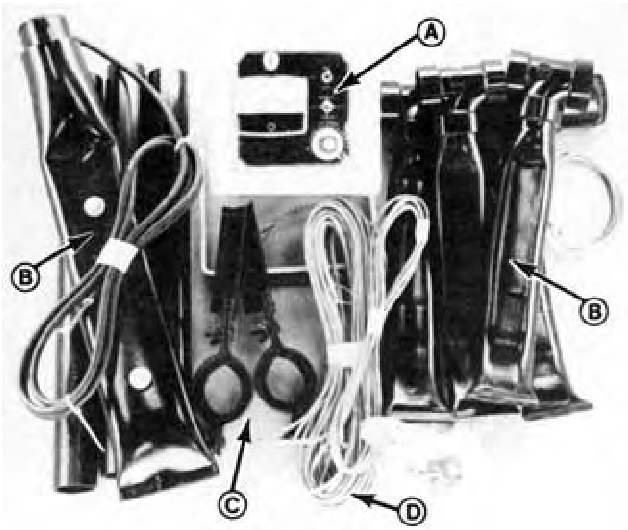

FIGURE 1. Sens-Saver SS2 Grain Loss Monitor: (A) Control Box (B) Sensor Assembly (C) Mounting Hardware (D) Wiring Harness.

SUMMARY AND CONCLUSIONS

The Sens-Saver SS2 Grain 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 lossrate. It could effectively be used to aid the combine operator in maintaining the feedrate at an efficient level.

Although the Senstek SS2 was effective in indicating changes in lossrate, its accuracy in indicating the actual grain lossrate was only fair. Monitor sensitivity was good in wheat and barley, but was poor in rapeseed.

Meter visibility was good both day and night. However, minimal damping of the meter allowed it to fluctuate occasionally, making it difficult to read.

The manufacturer's calibration procedure was very easy to perform as it simply involved setting the monitor according to a table in the operator's manual based on combine width and crop type. Although this procedure was useful in initially setting the monitor, additional field checks to suit varying crop conditions were necessary. The meter output, which was calibrated in bushels/hour loss, did not necessarily give accurate readings over a range of feedrates and should be used only as a guide in assessing relative lossrates.

It took about six man-hours to install the Senstek SS2 on a combine. The sensors had a unique mounting configuration, giving very good sampling of walker losses and both mechanical and airborne shoe losses.

The operator's manual was clearly written and well illustrated, containing detailed information on installation and use of the monitor.

One sensor failure occurred during testing.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the operator's manual to include a statement that occasional field loss checks should be conducted in conjunction with calibration to assess the effect of crop variables.

Chief Engineer -- E. 0 Nyborg
Senior Engineer -- L. G. Smith
Project Engineer -- D. E. Gullacher

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The following statement will be added to future operator's manuals. "After setting the calibration knob, occasional field checks should be conducted to ensure that the monitor is operating properly".

Manufacturer's Additional Comments

The 1978 model of the Sens-Saver has the following improvements over the 1977 model tested by PAMI:

1. The 1978 model has separate sensitivity adjustments for walker and shoe, making it easier to set for various combines.
2. The meter movement has increased damping.

GENERAL DESCRIPTION

The Sens-Saver SS2 Grain 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.

Moderately sized tube-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 Senstek SS2 may be powered by any 12V, positive or negative ground electrical system. Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Senstek SS2 was used on a combine for 239 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 six man hours to install the Senstek SS2 on a combine using standard tools found in most farm shops. Installation instructions were clear, well illustrated, and easy to follow.

Sensor Installation: The Senstek SS2 is supplied with two tube-type sensors (FIGURE 2) for mounting at the rear of the straw walkers and shoe.

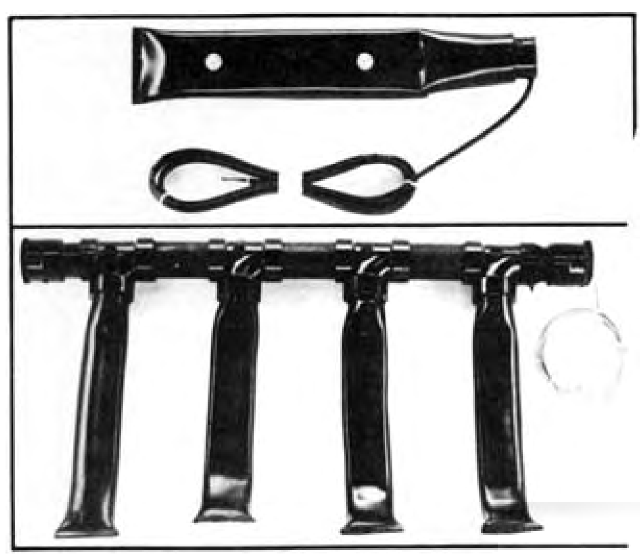

FIGURE 2. Sensors: Top -- Walker Sensor, Bottom -- Shoe Sensor.

The shoe sensor consists of four slender plastic tubes vertically mounted to a manifold, which contains the electronic sensing unit. The sensor must be cut to length and assembled before it is installed behind the shoe. The sensor tubes mount approximately 254 mm (10 in) above the shoe and extend to 76 mm (3 in) below the shoe surface giving good coverage of the shoe exit area.

The walker sensor is a single 460 mm (18 in) plastic sensing tube, and is mounted in the bottom of a closed straw walker. It may also be mounted on the grain pan under an open straw walker.

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 quick coupler is available for use on a pull-type combine.

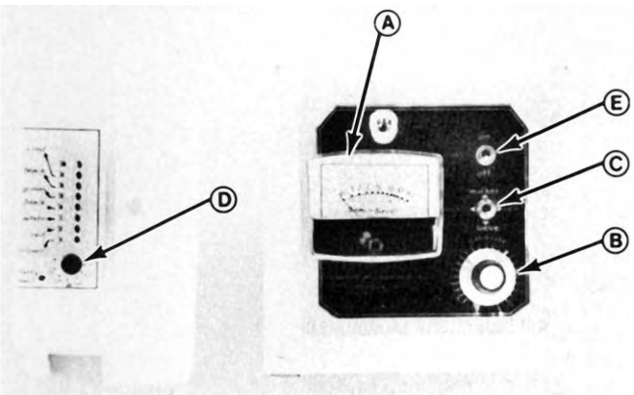

FIGURE 3. Control Box: (A) Loss Meter (B) Calibration Control (C) Sensor Selector Switch (D) Sensitivity Control (E) Power Switch.

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.

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. A simple calibration procedure is given in the operator's manual. The calibration control is set according to a chart, based on combine width and crop type. When set according to this chart the meter is intended to indicate grain loss in bushels per hour. It was found that when calibrated in this way, the meter did not necessarily indicate lossrate in bushels per hour accurately over a range of feedrates and should only be used as a guide in assessing relative lossrates.

The following procedure was found to be suitable for checking the calibration of the Senstek SS2.

First, set the combine for best performance in the crop being harvested and 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 an acceptable forward speed has been determined, the meter reading is noted while combining at this speed. This meter reading will then be known to relate to an acceptable loss level.

If the meter reading rises, losses are higher than desired and forward speed should be reduced. Conversely, if the meter reading drops, 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 easy.

Meter Readability: The meter was large enough to be readily visible and was well illuminated for night use.

Moderate fluctuations in combine lossrate, which are beyond operator control, often occur because the feedrate cannot be varied quickly enough to counteract them. A loss monitor must be damped just enough so that these fluctuations do not make the indicator difficult to read. Too much damping will cause the monitor to lag behind loss changes.

The Senstek SS2 meter was undamped and as a result the meter fluctuated during rapidly changing loss conditions, making it difficult to read.

QUALITY OF WORK ACCURACY

FIGURES 4 and 5 give comparisons of actual losses from a conventional combine to the losses indicated by the Senstek SS2 in fields of Neepawa wheat and Bonanza barley. These comparisons were conducted with the monitor calibrated according to the manufacturer's recommended procedure, which specifies that the meter is capable of reading actual lossrate in bushels/hour. The actual position of the monitor curve in relation to the actual lossrate curve is determined by the calibration control setting.

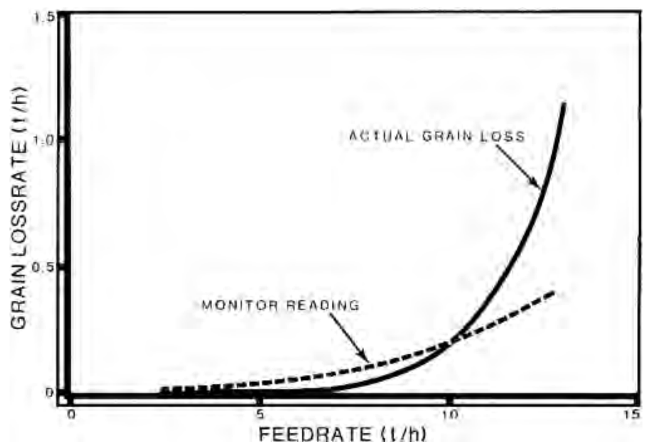

FIGURE 4. Comparison of Monitor Reading to Actual Combine Lossrate in a Field of Neepawa Wheat.

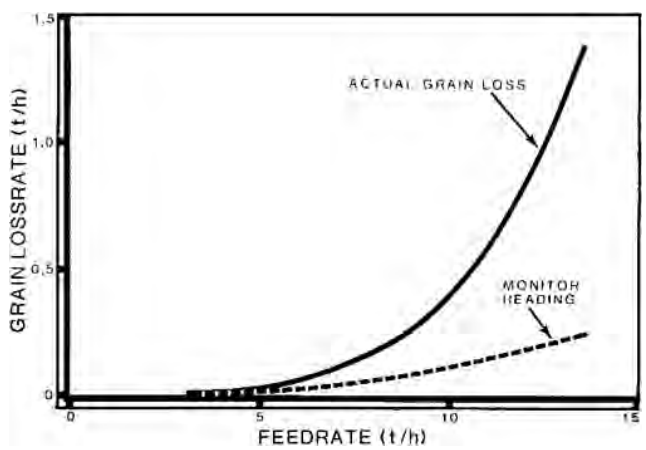

FIGURE 5. Comparison of Monitor Reading to Actual Combine Lossrate in a Field of Bonanza Barley.

From FIGURES 4 and 5 it can be seen that the meter reading approximately follows the lossrate at low feedrates. However, the meter does not follow the rapid increase in lossrate, which occurs at moderate feedrates. Therefore, if the monitor is used to measure the actual lossrate in bushels per hour over a range of feedrates, significant error should be expected.

In spite of errors in measuring actual lossrate the Senstek SS2 can be very 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 and the meter reading is noted at a feedrate of about 10 t/h, combine loss can be maintained at an acceptable level while operating the combine if combine speed is adjusted to hold the meter reading 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 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 Senstek SS2 had a sensitivity control for tuning to the particular grain being harvested. When properly adjusted, sensitivity was good in wheat and barley, but was poor 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 ratio of straw walker to shoe loss changes with crop type and conditions, 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 Senstek SS2 had a full width shoe sensor, which enabled it to monitor losses in sidehill combining. The shoe sensor design also enabled it to monitor airborne as well as mechanical shoe losses.

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, clearly written, and provided detailed information on installation and use of the monitor.

POWER REQUIREMENTS

The Senstek SS2 drew a maximum current of 0.13 A and could be attached to any 12 volt electrical system with positive or negative ground.

The meter often gave erratic readings because of electrical noise from the combine's electrical system. A noise suppressor is available from the manufacturer and can be attached to the monitor to eliminate this interference.

The meter also behaved erratically because of noise from the threshing mechanism. This interference could often be eliminated by adjusting the sensitivity control, although this reduced the sensitivity of the monitor.

DURABILITY RESULTS

The Senstek SS2 Grain Loss Monitor was operated in the field for 239 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:	Sens-Saver Grain Loss Monitor
MODEL:	SS2
SERIAL NUMBER:	768092
ELECTRICAL POWER REQUIREMENTS:	12V DC positive or negative ground
CONTROL BOX:	
-- size	162 x 162 x 82 mm (6.4 x 6.4 x 3.3 in)
-- weight	0.6 kg (1.3 lb)
-- display	59 x 59 mm (2.4 x 2.4 in) meter with needle indicator
-- controls	sensor selector, calibration adjustment, sensitivity adjustment, and power switch
SENSORS:	
-- number	2
-- type	plastic sounding tube
-- size - walker sensor	445 x 89 x 30 mm (17.5 x 3.5 x 1.2 in)
- shoe sensor	305 x 54 x 25 mm (12.0 x 2.2 x 1.0 in) sensor tubes mounted to a manifold, adjustable to combine width
WIRING HARNESS:	
-- power supply cables	1.2 m (3.9 ft)
-- sensor cables	1, 12.2 m (40.0 ft), 5 conductor, vinyl clad 1, 1.2 m (3.9 ft), 3 conductor, vinyl clad 1, 2.4 m (7.9 ft), 3 conductor, vinyl clad
OPTIONS:	pull-type cable extension and connector

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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