Evaluation Report No. E0676B
Printed: August, 1978
Tested at: Humboldt
ISSN 0383-3445

Evaluation Report 30

Smith-Roles GM30 Combine Grain Monitor

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

SMITH-ROLES GM30 COMBINE GRAIN MONITOR

MANUFACTURED AND DISTRIBUTED BY:

Smith-Roles Ltd.
Box 907
46 Street and Millar Avenue
Saskatoon, Saskatchewan
S7K 3M5

RETAIL PRICE:

$350.00 (July, 1978, f.o.b. Humboldt)

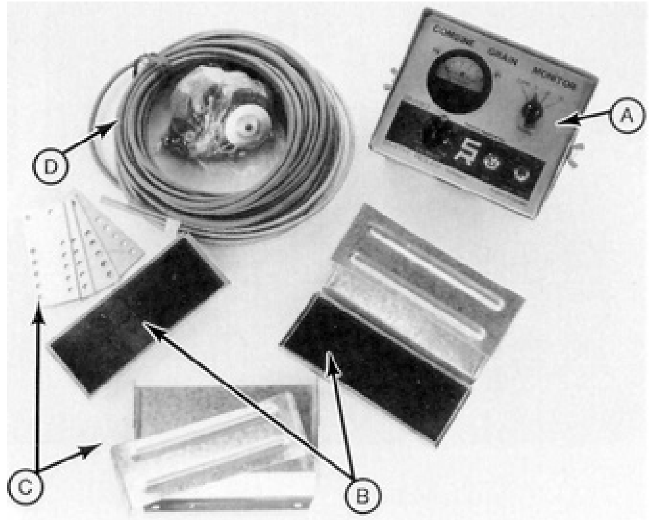

FIGURE 1. Smith-Roles GM30 Combine Grain Monitor: (A) Control Box (B) Sensors (C) Mounting Hardware (D) Wiring Harness.

SUMMARY AND CONCLUSIONS

The Smith-Roles GM30 combine grain monitor, when properly installed to suit combine characteristics and when calibrated to suit crop conditions, was a *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 Smith-Roles GM30 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* during both day and night operation. However, minimal damping of the meter allowed it to fluctuate occasionally which made it difficult to read.

The manufacturer's calibration procedure, suggested for experimental purposes, was difficult, time consuming, and erroneous. Since no alternate procedure was suggested for normal farm use, a simple calibration procedure was developed. Proper calibration to suit crop conditions was very important.

It took about five man hours to install the Smith-Roles GM30 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. It contained detailed installation instructions but lacked operating instructions and a simple calibration procedure.

Two sensor failures occurred during testing.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing a sensitivity adjustment on the control box.
2. Providing a simple calibration procedure.

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

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The sensitivity for the GM30 is set at an optimum value for the monitor to detect seeds and ignore chaff. A variable sensitivity would make it necessary for the user to determine the correct setting which could result in erroneous readings. A grain select switch has been incorporated into a new (Model 800) Grain Loss Monitor for those requiring increased accuracy in crops such as rapeseed and flax.
2. A simple calibration procedure will be added to the existing operator's manual.

MANUFACTURER'S ADDITIONAL COMMENTS

The sensor failures experienced during the testing program were probably due to the abnormal number of installations involved and are not representative of field performance. However, to eliminate almost every possibility of damage during installation, the sensor design has been changed.

GENERAL DESCRIPTION

The Smith-Roles GM30 combine grain 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 Smith-Roles GM30 may be powered by dry cells, housed in the control box, or any 12V, negative ground electrical system. Powering the monitor from a positive ground electrical system requires special precautions.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Smith-Roles GM30 was used consecutively on three different combines for 282 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 five man hours to install the Smith-Roles GM30 on a combine using standard tools found in most farm shops. Installation instructions were clear, well illustrated, and easy to follow.

Sensor Installation: The Smith-Roles GM30 is supplied with two 182 x 71 mm (7.1 x 2.8 in) pad-type sensors for mounting beneath the rear of the straw walkers and shoe.

The shoe sensor may be mounted on the back of the shoe. A deflector is supplied which can be installed to guide the grain loss onto the sensor.

The straw walker sensor may be mounted behind or beneath a straw walker. It can be mounted on the grain pan under an open walker or in the bottom of a closed straw walker. Mounting the sensor beneath the walker reduces the amount of straw that may strike the sensor. This may be an advantage when combining crops such as rapeseed where straw impacts cause the monitor to read erroneously.

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 sensor to intercept the flow of losses.

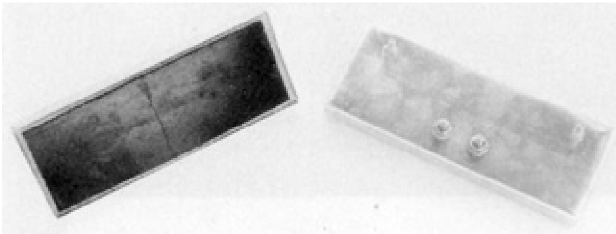

FIGURE 2. Sensors.

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 with a quick connector is available for use on pull-type combines.

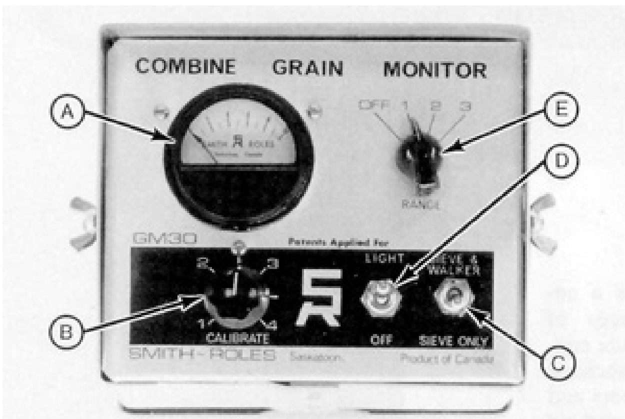

FIGURE 3. Control Box: (A) Loss Meter (B) Calibration Control (C) Sensor Selector Switch (D) Meter Illumination Switch (E) Power Switch and Meter Range Control.

EASE OF OPERATION AND ADJUSTMENT

Sensitivity Adjustment: Most loss monitors have a sensitivity adjustment which allows the monitor to be tuned to the type of grain being harvested. Sensitivity adjustment is necessary, especially if the monitor is to be used in the harvesting of a variety of grains such as wheat and rapeseed.

There is no sensitivity adjustment on the Smith-Roles GM30. The meter range control is described in the operator's manual as a sensitivity selector, but it is merely a calibration control and does not provide sensitivity adjustment as described above. It is recommended that a sensitivity adjustment be provided.

Calibration: 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, suggested for experimental purposes, was difficult, time consuming, and erroneous. Since no alternate procedure was suggested for normal farm use, the following simple procedure was used instead.

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. Since the meter range control on the control box provides the same adjustment as the calibration control, it does not have to be adjusted.

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 meter, although small, was readily visible during the day and was illuminated well for night use.

Moderate fluctuations in 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 meter difficult to read. Too much damping will cause the monitor to lag behind loss changes.

The Smith-Roles GM 30 was only slightly damped. This allowed moderate fluctuations to occur, making the meter difficult to read under rapidly changing loss conditions.

QUALITY OF WORK

ACCURACY

FIGURE 4 is a comparison of actual losses from a conventional combine to the losses as indicated by the Smith-Roles GM30 in a field of Bonanza barley. The manufacturer provides a procedure whereby the monitor can be calibrated to indicate the rate of grain loss in bushels per hour. This graph was prepared to illustrate the accuracy of the monitor in performing this. The position of the monitor curve in relation to the actual lossrate curve is 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. Therefore, if the monitor is used to measure combine loss in bushels per hour, significant error should be expected. The FIGURE shows that when properly calibrated, the Smith-Roles GM30 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 8 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.

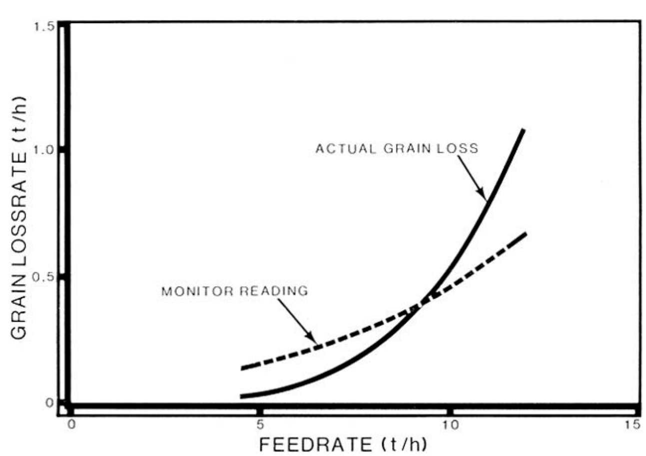

FIGURE 4. Comparison of Monitor Reading to Actual Combine Lossrate in a Field of Bonanza Barley.

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 Smith-Roles GM30 did not have a sensitivity control. Sensitivity was good in wheat and barley, but was poor in rape-seed.

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 Smith-Roles GM30 has only one small sensor for shoe sampling, but provision is made for the addition of more 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 charac-teristics 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, providing detailed information on monitor installation and use.

The calibration procedure, given in the operator's manual, was difficult and time consuming. However, the monitor could be easily calibrated using the procedure discussed under "EASE OF OPERATION AND ADJUSTMENT". It is recommended that the manufacturer provide a simple calibration procedure.

POWER REQUIREMENTS

The Smith-Roles GM30 drew a maximum current of 0.12 A and could be powered by dry cells or by any 12 volt electrical system with negative ground. Powering the monitor from a positive ground system required special precautions.

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

DURABILITY RESULTS

The Smith-Roles GM30 combine grain monitor was operated in the field for 282 hours. The intent of the test was functional evaluation and an extended durability evaluation was not conduct-ed. Two sensor failures occurred during the test.

APPENDIX I

SPECIFICATIONS

MAKE:	Smith-Roles Combine Grain Monitor
MODEL:	GM30
ELECTRICAL POWER REQUIREMENTS:	12V DC
CONTROL BOX:	
-- size	168x140x160 mm (6.6x5.5x6.3 in)
-- weight	1.37 kg (3.0 lb)
-- display	80 mm (2.4 in) diameter meter with needle indicator
-- controls	sensor selector, meter range adjustment, and calibration adjustment
SENSORS:	
-- number	2
-- type	plastic pad-type sounding board
-- size	182x71x15 mm (7.1x2.8x0.6 in)
-- weight	0.12 kg (0.3 lb)
WIRING HARNESS:	
-- power supply cable	305 mm (1.0 ft)
-- sensor cables	1, 11.7 m (38.4 ft), 3 conductor, shielded and vinyl clad 2, 1.5 m (5.0 ft), 2 conductor, vinyl clad
OPTIONS:	pull-type cable extension and connector extra sensors and cable

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)

ALBERTA FARM MACHINERY RESEARCH CENTRE

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute

Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:

P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080