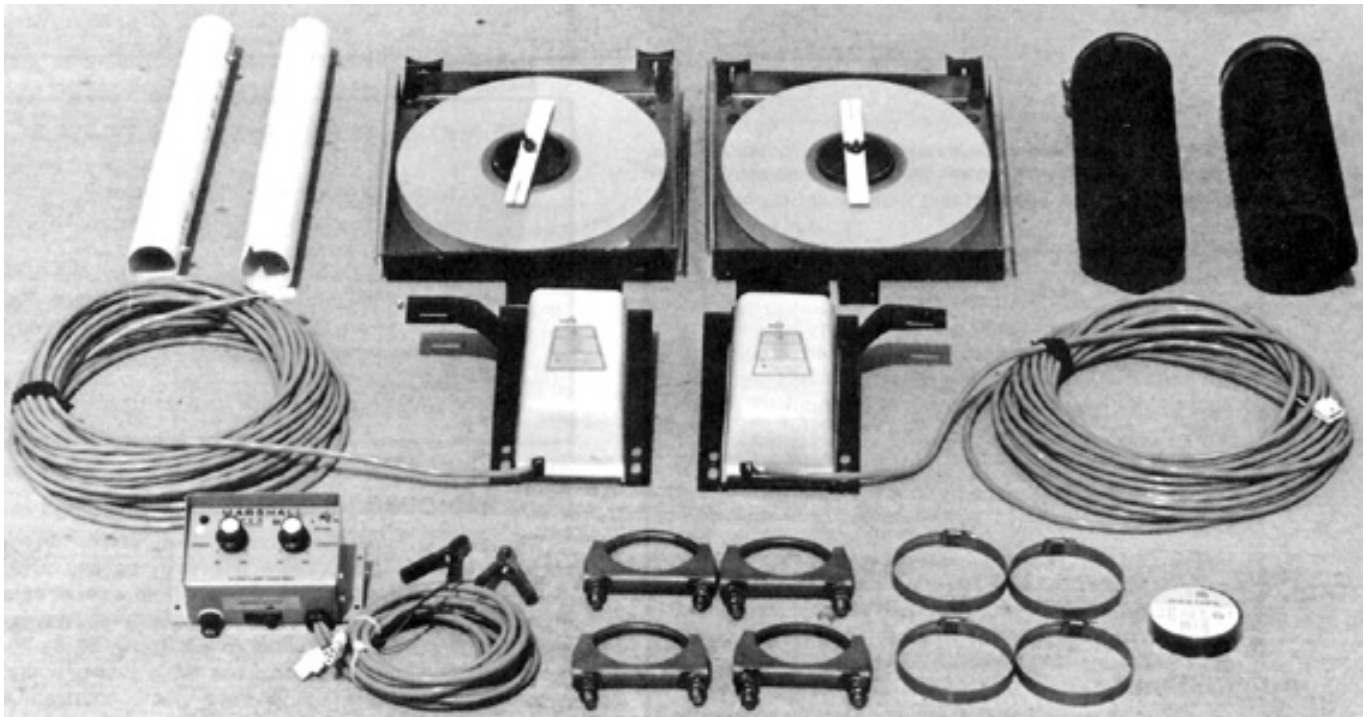


Evaluation Report

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Marshall Paper Field Marker

A Co-operative Program Between



ALBERTA
FARM
MACHINERY
RESEARCH
CENTRE



PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

MARSHALL PAPER FIELD MARKER

MANUFACTURER AND DISTRIBUTOR:

Marshall Marking Systems Ltd.
Box 165
Turtleford, Saskatchewan
S0M 2Y0

RETAIL PRICE: (June, 1987, f.o.b. Lethbridge, Alberta).

- a) Paper Marker \$745.00
- b) Replacement Paper Rolls - white \$4.95
- orange \$6.95

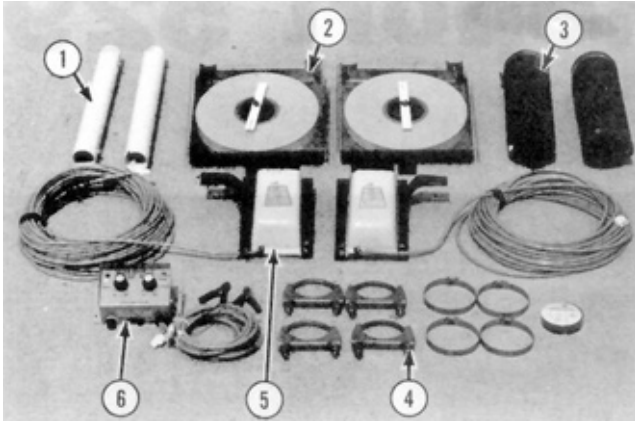


FIGURE 1. Marshall Paper Field Marker: 1) Paper Guide Tubes, 2) Paper Cassettes, 3) Windguard Tubes, 4) Mounting Hardware and Tape, 5) Cradles with Wiring Harness, 6) Control Box.

SUMMARY AND CONCLUSIONS

Quality of Work: Mark visibility was very good as long as mark length and spacing were adjusted to suit field conditions. For best visibility, the paper marks had to be about 40 in (1016 mm) long and spaced about 100 to 150 ft (30 to 46 m).

Mark durability was very good. The paper lasted several days.

Mark placement was good in calm weather and poor in light winds. In 5 mph (8 km/h) winds, the paper drifted about 7 ft (2.1 m) from the sprayer boom end.

A typical area marked by one roll of paper was about 75 ac (30 ha) using a 60 ft (18 m) sprayer with marker spacing of about 100 ft (30 m) and marker length of 40 in (1016 mm). Operating cost for paper was about 7 cents/ac (17 cents/ha).

Ease of Operation and Adjustment: Controls were very good. The control box switches were easy to use and responsive. Ease of adding paper was very good. The compact paper rolls were easily and quickly placed inside the paper cassette and through the cradle rubber rollers.

Good operator skill and judgement was required to align the sprayer boom end with the paper mark. This was more difficult with wider sprayers.

Ease of delivering paper through the windguard tube was poor. Static electricity caused the paper to stick to the windguard tube walls, especially in hot and dry weather conditions. As a result, the paper plugged the windguard tube and wrapped around the marker cradle rollers. Spraying water on the paper roll and marker assembly temporarily stopped paper sticking, but was inconvenient and time consuming.

Ease of Installation: The paper marker components were easily installed on a Flexi-coil field sprayer in about three hours by one man. Brackets were built to mount the marker cradles and paper cassettes on the square booms of the sprayer used. The components were light weight

but large, and would be difficult to install on some sprayer booms.

OPERATORS MANUAL

The operator's manual was useful.

MECHANICAL HISTORY

A few mechanical problems occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the mounting brackets so that the marker could be mounted on sprayers with square and truss-like booms.
2. Modifying the marker to prevent the paper from plugging the windguard tubes due to static electricity.
3. Modifying the marker to prevent the paper from drifting in light winds.

Station Manager: R. P. Atkins

Project Technologist: L. B. Storzynsky

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The mounting brackets for a square or truss-like boom are available from the manufacturer.
2. Since May 2, 1987 we have installed Copper Anti-Static Tinsel below the cutting knife on the standard. Field tests have proven this very effective in eliminating or neutralizing static electricity.
3. Setting the control timer to drop 40" to 50" strips of paper help's prevent paper from drifting.

GENERAL DESCRIPTION

The Marshall Paper Field Marker is mounted on field sprayers to aid in aligning successive passes in the field. A 12 VDC electric motor delivers a strip of paper from a paper cassette through a pair of rubber rollers and then cuts the paper with a knife. The electric motor, rubber rollers and knife are housed in a cradle that mounts on either end of the sprayer boom. The paper cassette mounts near the cradle. Both length and spacing of the paper strip are adjustable from the control box mounted on the tractor.

FIGURE 1 shows the components of the marker while detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Marshall Paper Marker was mounted on an 81.7 ft (29.9 m) Flexi-coil field sprayer and used for 107 hours of typical spraying. Laboratory tests were also conducted to aid evaluation.

The Marshall marker was evaluated for quality of work, ease of operation and adjustment, ease of installation, operator safety and suitability of the operator's manual.

RESULTS AND DISCUSSION

QUALITY OF WORK

Mark Visibility: Paper mark visibility depended on field surface, operator sight, paper length and spacing. Paper mark visibility was very good in most field conditions encountered as long as paper mark length and spacing were adjusted to suit forward speed and field conditions. The paper marks were best visible on level fields with young green crops where mark spacings of

about 150 ft (46 m) could be used. The paper marks were less visible on no-till and stubble fields, where the distance between marks had to be spaced about 100 ft (30 m) for good visibility. Paper marks spaced too far apart caused the operator to search for the next mark which resulted in a zig zag spraying pattern. In addition, more paper was used at large mark spacings because the mark length usually had to be increased for good visibility.

For best visibility, the marks had to be about 40 in (1016 mm) long and bunched up on top of the field canopy. The paper marks were much less visible when the paper fell in a straight line between the crop rows.

Mark Durability: The paper mark remained visible for several days and normally decomposed within one crop season.

Mark Placement: The paper marks landed at various lateral distances from the boom end because air turbulence behind the sprayer and light winds caused the paper to drift. In calm conditions the paper would sometimes float a couple of feet from the sprayer boom end. In about 5 mph (8 km/h) winds the paper drifted about 7 ft (2.1 m) from the desired mark placement. When the paper was blown towards the sprayer, the paper got caught in the sprayer boom.

In breezy weather conditions the operator constantly had to watch how far the paper landed from the desired mark placement to compensate on the successive pass. Watching the paper landing made it difficult to properly align the sprayer boom end with the coming marks. It is recommended that the manufacturer consider modifying the marker to prevent the paper from drifting in light winds.

Quantity of Paper Used: The amount of paper needed depended on field surface, field topography, sprayer size and operator skill. The length of paper cuts could be set from about 5 to 130 in (127 to 3300 mm) and the time or spacing between paper marks could be set from about 3 to 56 seconds. This meant that a roll of paper could cover from 41 to 1380 ac (17 to 559 ha) using a 60 ft (18 m) sprayer at 5 mph (8 km/h). However, a typical area marked by one roll of paper was about 75 ac (30 ha), using a 60 ft (18 m) sprayer with mark spacing of about 100 ft (30 m) and a mark length of 40 in (1016 mm).

Operating cost for paper was about 7 cents/ac (17 cents/ha).

Environmental Effects: The performance of the control box, cradle and wiring harness was not affected by the dust or moisture common to spraying operations.

EASE OF OPERATION AND ADJUSTMENT

Adding Paper: The paper came in compact rolls and were easily positioned inside the marker cassette. The paper was easily threaded from the paper cassette through the plastic paper feed tube by the tool provided. The tool secured to the top of the cassette lid when not in use.

Controls: FIGURE 2 shows the control box on the Marshall Paper Marker. All controls were convenient to operate and responsive. A manual-override control would be useful in providing extra marks on corners and during turns.

Operation of the control box required the operator to turn on the power switch and set the control switch to operate either the left or right end paper marker. The space between marks and length of mark were easily adjusted by the control knobs. At a desired space setting it was important to remember the spacing between marks increased with increased paper length settings. The additional time needed to deliver the extra length of paper resulted in increased spacings between paper marks.

Field Operation: The paper marks allowed successive passes of the sprayer to be properly aligned (FIGURE 3). Marks were left at the outer edge of the previous round, so on the next round an operator could eliminate most sprayer misses or overlaps by aligning the outer end of the spray boom with the marks. This still required considerable operator skill and judgement, since with most sprayers, the outer end of the booms were over 30

ft (9 m) from the tractor and the sprayer could not be aligned by sighting down the row of marks. The operator had to judge the distance from the mark to where he should be driving and then use the mark as a check to see if the sprayer was properly aligned.

From the tractor seat, the sprayer boom end may seem properly aligned with the mark, when in fact the mark could be several feet from the sprayer boom end. It is recommended the operator frequently get off the tractor and check the mark with respect to the sprayer boom end, and make adjustments accordingly.



FIGURE 2. Control Box.

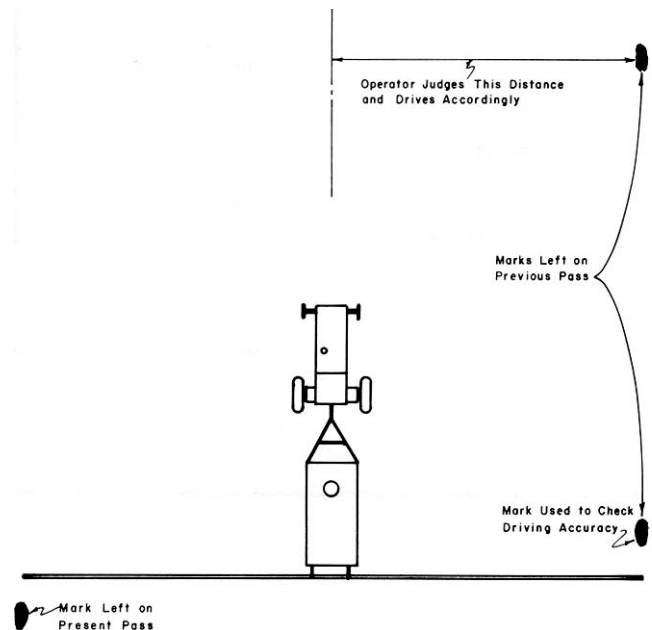


FIGURE 3. Schematic Illustrating Marshall Paper Marker Operation.

Paper Delivery: Static electricity caused the paper to stick to the windguard tube wall and plug the windguard tube (FIGURE 4). Spraying water on the paper roll and windguard tube, as recommended by the manufacturer, temporarily stopped the paper sticking to the windguard tube. In Southern Alberta, the hot and dry conditions usually encountered during spraying caused the windguard tubes to plug several times an hour.

The operator constantly had to watch the paper feeding through the windguard tube to avoid plugging. If a plugged windguard tube was not noticed quickly, the paper wrapped around the cradle rubber rollers (FIGURE 5). Removing the wrapped paper was difficult and required the use of a tool. Care had to be exercised to avoid bending the cradle assembly paper guides against the rubber rollers. Bent paper guides accelerated roller wear.



FIGURE 4. Plugged Windguard Tube.

Wetting the marker system several times an hour was inconvenient and time consuming. Wetting the paper roll too much caused the paper roll core to expand against the paper cassette core. The paper roll would not turn as easily causing the paper to tear. It is recommended that the manufacturer consider modifying the marker to prevent the paper from plugging the windguard tubes due to static electricity. Spraying without the windguard tubes caused the paper to drift in light winds or tangle in the sprayer booms.

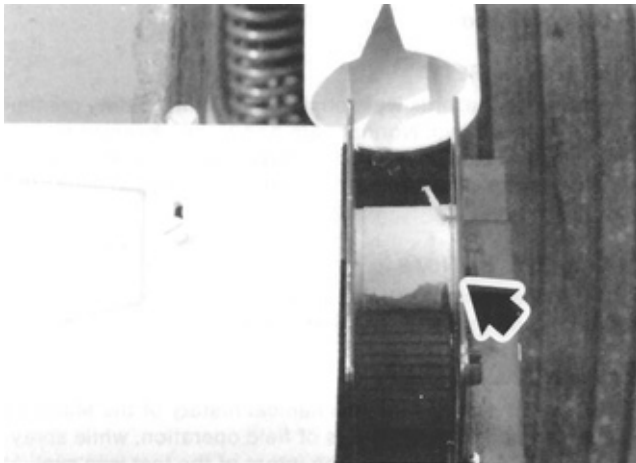


FIGURE 5. Paper Wrapped Around Cradle Roller.

EASE OF INSTALLATION

Installation Time: The Marshall Paper Marker was easily installed on the Flexi-coil sprayer in about three hours by one man. Brackets were built to support the cradles and paper cassettes on the Flexi-coil sprayer boom. The components were light-weight but large and would be difficult to install on some sprayer booms.

Installation instructions provided were clear and well illustrated.

Control Box and Wiring: The control box (FIGURE 1) was mounted at a suitable location on the tractor with four screws. Clamps were supplied to connect the control box cable to the tractor battery. On some larger tractors the control box cable was too short to reach the battery terminals. The clamps were taken off and the control box cable was wired directly into the tractor electrical system. Pull-apart connectors were provided to disconnect the control box when unhitching. The cables from the cradles were easily fastened along the sprayer boom and trailer with tape.

Cradle and Paper Cassette: The cradle and paper cassette were mounted at the sprayer boom end (FIGURE 6). Brackets were built to secure the cradles and paper cassettes on the Flexi-coil sprayer 4 in (101.6 mm) square boom. The 3 in (76 mm) U-bolt and gear clamps provided were not useful and could be used only on sprayers with 3 in (76 mm) round booms. Building brackets was time consuming and inconvenient. It is recommended that the manufacturer consider modifying the mounting brackets so that the marker could be mounted on sprayers with square and truss-like booms.

No provisions were provided to mount the paper marker 10 in (254 mm) out from the end nozzle for proper sprayer nozzle overlap on the successive pass.

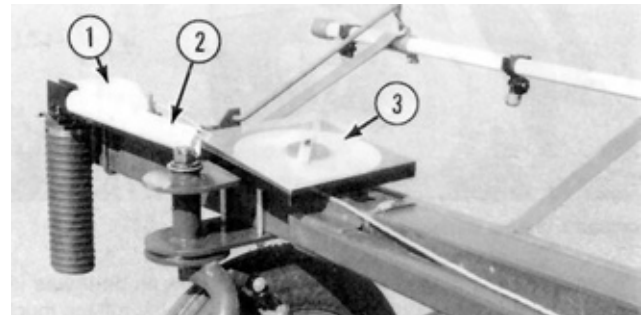


FIGURE 6. Cradle and Paper Cassette Mounting: (1) Cradle, (2) Paper Guide Tube, (3) Paper Cassette.

tubing: The windguard tubes were easily fastened to the cradles by the gear clamps provided. The plastic paper feed tubes were easily fastened to the cradle and paper cassette ends by bolts provided.

OPERATOR SAFETY

No safety hazards were observed if normal safety precautions were observed. Normal care had to be observed to prevent a hand from coming into contact with the knife when removing strips of paper that frequently got plugged inside the windguard tube.

OPERATOR'S MANUAL

The operator's manual included useful information on installation and operation. A parts list was also provided.

MECHANICAL HISTORY

TABLE 1 outlines the mechanical history of the Marshall Paper Marker during 107 hours of field operation, while spraying about 3623 ac (1467 ha). The intent of the test was evaluation of the functional performance and an extended durability evaluation was not conducted.

TABLE 1. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA	
		ac	(ha)
- the paper piled up inside the windguard tube and wrapped around the rubber rollers		throughout the test	
- the right cradle housing bent and the paper cassette lid broke at	15	550	(223)
- the paper feed roller shafts squeaked after	19	650	(263)
- the right cradle cutting knife was not returning and the knife linkage was adjusted at	26	975	(395)
- the left cradle feed roller rotated intermittently and the cradle was replaced at	29	1045	(423)
- the left cradle feed rollers were worn and replaced at	29	1045	(423)

DISCUSSION OF MECHANICAL PROBLEMS

Marker Cradle and Paper Cassette: The cradle and paper cassette components were large and protruded in front of the booms. Care had to be exercised when operating the sprayer boom ends near fence lines and other foreign objects.

Cradle Paper Feed Rollers: One cradle paper guide was accidentally pressed into the rubber roller when removing paper wrapped around the roller. The rubber roller wore quickly as a result.

Paper Feed Roller Shafts: The paper feed roller shafts squeaked and were lubricated. The lubricant got between the rubber roller and shaft causing the roller to rotate intermittently. Attempts to dry the shaft and rubber roller didn't help and the entire cradle was replaced.

**APPENDIX I
SPECIFICATIONS**

MAKE:	Marshall Paper Marker
MODEL:	SK
SERIAL NUMBER:	1776
ELECTRICAL POWER REQUIREMENTS:	
- volts	12 VDC
- current draw	0.5 to 3.5 A
CONTROL BOX:	
- size	6.3 x 3.0 x 3.0 in (160 x 77 x 77 mm)
- controls	power on-off, mark length, distance between marks, left or right marking
MARKING SYSTEM:	
- type	paper
- paper roll	about 1800 ft (54.9 m)
- paper cassette size	11.2 x 11.2 x 1.5 in (285 x 285 x 38 mm)
MARK DELIVERY SYSTEM:	
- paper guide tube	two, plastic, 18 in (457 mm) long, 2 in (51 mm) dia.
- paper cradle	two
- size	5.5 x 9 x 2.6 in (140 x 229 x 66 mm)
- motor	12 V, drives rubber roller
- solenoid	12 V, operates paper cutting knife
- windguard tube	two, 13 in (330 mm) long, 4 in (102 mm) dia.
WIRING HARNESS:	
- power cable	84 in (2130 mm) long
- cradle cable	66 ft (20.1 m) long
MOUNTING HARDWARE:	
- U-bolt clamps	four, 3/8 in (9.5 mm) bolts
- ring clamps	four, 3 in (76 mm) dia.
WEIGHT:	
- paper cassettes	8.9 lbs (4047 g)
- paper cradles	13.2 lbs (5972 g)
- control box	2.0 lbs (904 g)
- tubes and hardware	<u>4.6 lbs (2107 g)</u>
Total	28.7 lbs (13030 g)

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

- Excellent
- Very Good
- Good
- Fair
- Poor
- Unsatisfactory

APPENDIX III

CONVERSION TABLE

acres (ac) x 0.40	= hectares (ha)
miles/hour (mph) x 1.61	= kilometres/hours (km/h)
feet (ft) x 0.305	= metres (m)
inches (in) x 25.4	= millimeters (mm)
pounds mass (lb) x 0.45	= kilograms (kg)

**SUMMARY CHART
MARSHALL PAPER FIELD MARKER**

RETAIL PRICE:	\$745.00 (June, 1987, f.o.b. Lethbridge)
QUALITY OF WORK:	
Mark Visibility	Very good; at suitable paper mark spacings and lengths
Mark Durability	Very good; useful for several days
Mark Placement	
- calm weather	Good; paper floated
- light winds	Poor; paper drifted
Quantity of Paper Used	
- area marked	About 75 ac/roll (30 ha/roll)
- cost	About 7 cents/ac (17 cents/ha)
EASE OF OPERATION AND ADJUSTMENT:	
Controls	Very good; convenient and responsive
Adding Paper	Very good; quick and simple
Field Operation	Good; required good judgement
Paper Delivery	Poor; windguard tube plugged frequently
EASE OF INSTALLATION:	Good; one man about 3 hours
OPERATOR'S MANUAL:	Very good; useful
MECHANICAL HISTORY:	A few minor problems occurred



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