

Evaluation Report

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Marshall Model 5520 Foam Marker

A Co-operative Program Between



MARSHALL MODEL 5520 FOAM MARKER

MANUFACTURER AND DISTRIBUTOR:

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

RETAIL PRICE: \$895.00

(July, 1989, f.o.b. Lethbridge, Alberta)

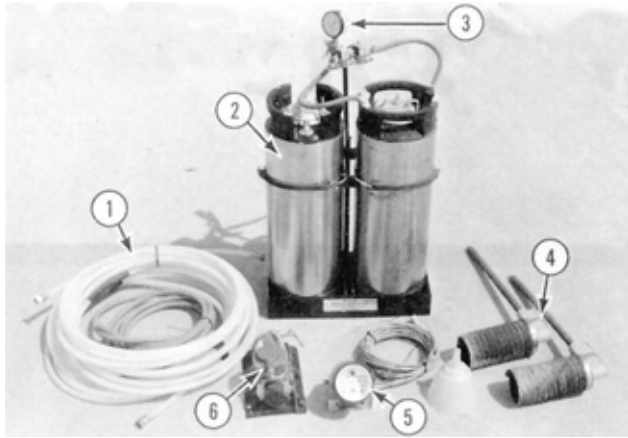


FIGURE 1. Marshall Model 5520 Foam Marker: (1) Foam Tubes, (2) Foam Tank, (3) Pressure Gauge, (4) Boom End Funnels, (5) Control Console, (6) Compressor.

SUMMARY AND CONCLUSIONS

Quality of Work: Mark visibility was good. Average foam marker size and spacing were about 5 in (127 mm) and 50 ft (15 m), respectively, making the marks easily visible without searching. The foam marks were less visible in tall crops.

Foam mark durability was good, normally lasting up to one hour. Depending on weather conditions, the foam marks could last less than 15 minutes to as long as 4 hours.

Quality of foam varied depending on weather and water conditions and was rated as good.

One tank of foam lasted about 120 ac (49 ha) using a 60 ft (18 m) sprayer at 5 mph (8 km/h). Operating cost for foam was about 10 cents/ac (25 cents/ha).

Marker component performance was good in the dust and moisture common to spraying operations.

Ease of Operation and Adjustment: Ease of refilling the foam tank with water and foam concentrate was fair. The water and foam concentrate had to be premixed in another container and then poured through a long stemmed funnel to reduce foaming.

The control console switches were easy to use and rated as very good. Although the foam solenoid valves were responsive it took over a half a minute to produce the first quality foam after switching the foam control toggle switch. When spraying up and down the field, over 200 ft (61 m) was unmarked after turning.

Ease of cleaning was fair. The foam tank was portable and easily removed for cleaning. The foam tank and tubes had to be flushed with hot boiling water when the foam fluid jelled.

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

Ease of adjusting foam marks was fair. The foam regulating orifice plate was easily changed to accommodate different spraying operating speeds. Foam mark spacing and size could not be adjusted to suit field and weather conditions.

Ease of Installation: Ease of installation was very good. The Marshall foam marker components were small and easy to install on most field sprayers. Installation time was about 3 hours for one man.

OPERATOR'S MANUAL

The operator's manual was fair. It was useful but contained no information on foam mark size, spacing, quality and durability.

MECHANICAL HISTORY

The air compressor shut-off switch was inconsistent, which resulted in the motor not starting or stopping at the desired pressure limits.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the system to produce foam marks immediately after switching the foam toggle switches.
2. Modifying the marker to prevent foam solution from escaping from the foam tubes when cleaning the strainers or changing the orifice plates.
3. Modifying the operator's manual to include information on foam spacing, size, quality and durability.

Manager: R. R Atkins

Field Technologist: Brian Sturozynsky

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. To have this machine make instant marks would cost \$150 extra. We have decided against this outlay of cash.
2. Shut air compressor off and open sniffer valve located on top of tank. This will release the pressure in 15 seconds or less.
3. This information will be included in the 1990 instruction books.

GENERAL DESCRIPTION

The Marshall Model 5520 Foam Marker mounts on field sprayers to aid in aligning successive passes in the field. A 12 V compressor pressurizes a 4.25 gal (19.4 L) portable tank that delivers foam to funnels mounted at each end of the sprayer booms. The 3.5 in (89 mm) foam funnels deliver cylindrical shaped foam. A control console mounted on the tractor turns the power on and controls foam flow to each boom end.

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

SCOPE OF TEST

The Marshall Foam Marker was mounted on a 70 ft (21.3 m) trailing field sprayer and used for 79 hours of typical spraying. The Alberta Farm Machinery Research Centre (AFMRC) evaluated the foam marker for quality of work, ease of operation and adjustment, ease of installation, operator safety and suitability of the operator's manual.

During the final stages of preparing this report, Marshall Marking Systems Ltd. supplied an updated version of the foam marker system. Changes introduced were a new compressor shut-off switch, new foam concentrate, smaller foam funnels and the solenoid valves at the boom ends. Also, the 0.5 in (13 mm) foam delivery hose was replaced with two 0.25 in (6.4 mm) hoses to deliver air and foam fluid separately to the

boom end. APPENDIX II shows detailed specifications of the modified Marshall foam marker system. The modified Marshall Foam Marker System was evaluated in lab conditions for comparative purposes. Limited testing showed no significant differences between the old and new systems regarding foam delivery and quality. However, differences may occur under actual field spraying conditions. This report is based on the original foam marking system, unless indicated otherwise.

RESULTS AND DISCUSSION

QUALITY OF WORK

Mark Visibility: Foam mark visibility was good. Foam mark spacings averaged about 50 ft (15 m). The close spacing made the foam marks easily visible without searching. The foam marks were best visible on green crops less than 7 in (178 mm) high. The foam marks were less visible in tall crops and chem-fallow fields due to the foam marks falling below or being smeared across the top of the tall surface canopies.

The foam mark lengths averaged about 5 in (127 mm), but in cool weather conditions the length increased to about 8 in (203 mm), enhancing mark visibility.

Mark Durability: Foam mark durability was good. The foam marks normally lasted about 1 hour, but this was reduced to less than 15 minutes in hot breezy weather conditions. On cool, damp, cloudy mornings the large foam marks could last up to 4 hours.

Mark Placement: Foam mark placement was good. In typical spraying conditions the foam marks landed directly below the foam funnels. In breezy weather conditions the foam marks drifted and the drift distance had to be compensated for on the successive pass. Extra foam marks could not be placed during turning and cornering, where marking is usually needed most.

Quality of Foam: The foam generated by the compressor at the foam tank (FIGURE 2) was rated as good. The quality of foam varied, depending on weather and water conditions. The operator continually had to adjust to changes in size, spacing and durability of the foam mark.

The modified foam marker system generated foam at the boom end (FIGURE 3) rather than at the foam tank. Limited lab tests showed no significant difference in quality of foam generated at the boom end.

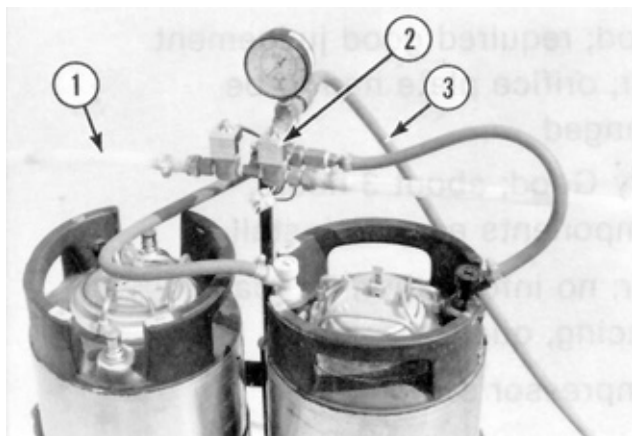


FIGURE 2. Foam Generation at Foam Tank: (1) Foam Outlet Hose, (2) Foam Solenoid Valves, (3) Air Inlet Hose.

Quantity of Foam Used: It took about 3 hours to empty the foam solution from the 4.25 gal (19.35 L) foam tank. About 120 ac (49 ha) could be marked using a 60 ft (18.3 m) sprayer at 5 mph (8 km/h). This represents an operating cost of about 10 cents/ac (25 cents/ha).

Environmental Effects: The Marshall foam marker component performance in field conditions was rated as good. The control console, compressor, foam tank, solenoid valves and wiring harness were not affected by the dust and moisture

common to spraying operations. The foam had no adverse effect on the crop or operator.

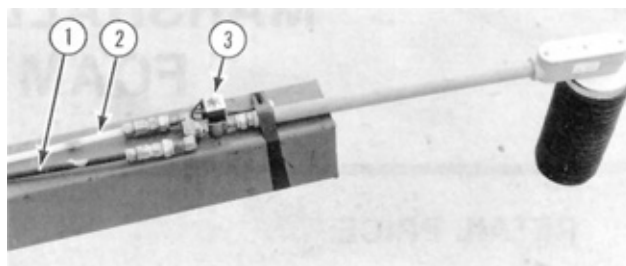


FIGURE 3. Foam Generation at Boom End: (1) Air Hose, (2) Foam Fluid Hose, (3) Foam Solenoid Valve.

EASE OF OPERATION AND ADJUSTMENT

Refilling: Ease of refilling the foam tank with water and foam concentrate was fair. The foam concentrate was supplied in 8.8 oz (250 mL) containers. The original foam concentrate supplied was in a semi-solid state and had to be placed in hot water for about 15 minutes to liquify. The new foam concentrate was in a liquid state and convenient to use. To ensure a homogeneous mixture and to reduce foaming, the water and foam concentrate had to be premixed in another container and then poured into the foam tank using the long stemmed funnel (FIGURE 4) provided. This was inconvenient and foaming still occurred making it difficult to see the water level inside the foam tank.

The foam solution jelled when left in the tank for an extended period of time. If left unused for more than two days, the foam solution had to be warmed in order to liquify the foam solution. A foam solution indicator was not provided on the foam tank. The level of foam solution in the tank had to be judged by opening the foam tank lid and peering into the tank. This was inconvenient since the foam on top of the fluid obstructed the foam solution level. The foam tank was easily decompressed by opening the pressure relief valve on top of the foam tank lid.

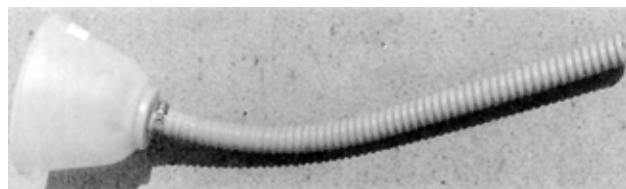


FIGURE 4. Refilling Funnel with Strainer.

Controls: Ease of operating the controls was very good. FIGURE 5 shows the Marshall foam marker control console. The control console was equipped with toggle switches for power and the foam solenoid valves. The foam solenoid switch controlled the flow of foam to either the left or right foam funnels.

At the start of each day, it took about two minutes to produce the first useful mark after turning the system on. At 5 mph (8 km/h) two minutes translates into 880 ft (268 m) of unmarked distance. Therefore, it is recommended the operator let the system run until a quality foam mark is produced before starting to spray.

Even though the boom end solenoid valves opened immediately, a foam mark was not usually produced immediately after switching the boom toggle switch. It took about 30 to 50 seconds before a quality foam mark was produced. As a result, 220 to 370 ft (67 to 113 m) was unmarked after switching boom sides during a turn when spraying up and down the field. It is recommended the manufacturer consider modifying the system to produce foam marks immediately after switching the foam toggle switches.

The foam tank operating pressure was preset at the factory and operated from 30 to 36 psi (207 to 248 kPa).

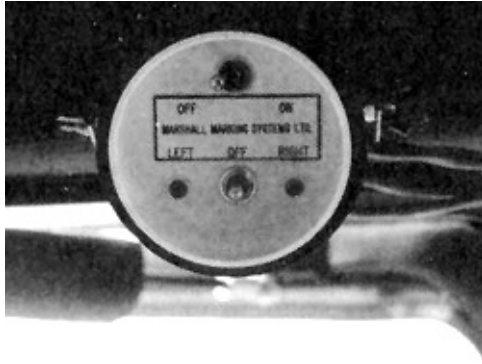


FIGURE 5. Control Console.

Cleaning: Ease of cleaning the Marshall foam tank was fair. The foam tank was portable and was easily removed from the stand for rinsing. The foam solution jelled slightly a few times during the test and plugged the strainers. The manufacturer recommended using boiling water to flush the system if the foam solution jelled severely.

Removing the strainers or orifice plates on the modified system for cleaning was messy and wasted foam solution. The foam solution leaked when the foam hose was disconnected at the solenoid valves. It is recommended the manufacturer consider modifying the marker to prevent foam solution from escaping from the foam tubes when cleaning the strainers or changing the orifice plates.

Sprayer Alignment: Ease of aligning the sprayer boom end to the mark was good. The foam marks allowed successive passes of the sprayer to be properly aligned (FIGURE 6). Marks were left at the outer edge of the previous pass, so on the next pass 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 ends 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 on whether the sprayer was properly aligned. From the tractor seat the sprayer boom end may seem properly aligned with the foam mark, when in fact the mark could be several feet from the sprayer boom end. At first the operator should get off the tractor and check the mark with respect to the sprayer boom end, and make adjustments accordingly. With experience the adjustment will come automatically.

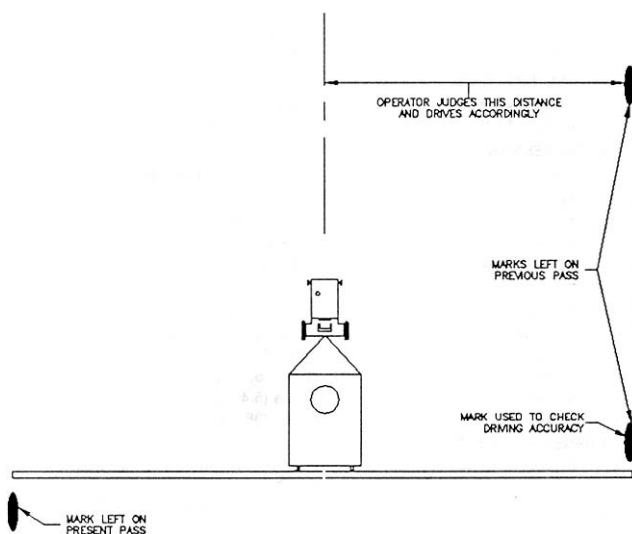


FIGURE 6. Schematic Illustrating Marshall Foam Marker Operation.

Mark Adjustments: Ease of adjusting foam marks was good. The foam regulating orifice plates could easily be changed to accommodate different sprayer speeds to keep the mark spacings close. Orifice size was predetermined by the manufacturer based on the type of sprayer and speeds used.

Foam mark spacing and size could not be adjusted to suit immediate field and weather conditions. Foam was dispensed on a consistent basis with the power and foam solenoid switches on. Foam mark spacing varied from about 20 to 120 ft (6 to 37 m) using the 4916-22 orifice plate at a 5 mph (8 km/h) spraying speed. Foam mark spacing was adequate for most spraying conditions. Lag time when switching from one boom to the other did result though in the first foam mark being placed too far from the headland.

Foam mark length varied from about 2 to 12 in (51 to 305 mm). FIGURE 7 shows a typical foam mark produced. The foam mark length depended on the quality of foam and boom end vibration. Light and dry foam, normally produced in the afternoons resulted in foam marks less than 4 in (100 mm) long. These foam marks were normally small, reducing visibility in tall crops or chemfallow fields. In addition, the small marks disappeared faster in hot weather conditions. The wet foam marks, produced in cool weather conditions, were up to 12 in (305 mm) long. The larger foam marks were more visible and lasted longer. Excessive boom end vibration decreased foam mark length. Adjusting mark length would be beneficial in adverse weather and crop conditions.



FIGURE 7. Typical Foam Mark.

EASE OF INSTALLATION

Installation Time: Ease of installation was very good. The Marshall foam marker was easily installed on the Brandt sprayer in about 3 hours by one man. Installation instructions provided were useful.

Foam Tank: The foam tank was mounted on the stand provided. The stand was secured on the sprayer frame at a location that provided convenient access for reloading. A suitable location on most sprayers was on the sprayer trailer hitch.

Compressor and Control Console: The compressor (FIGURE 1) and control console were mounted at suitable locations on the tractor. Both units were small and easy to install. A quick electrical pull-apart connector was provided to disconnect the control console when unhitching the tractor.

Wiring Harness and Delivery Tubes: The wiring harness, foam and air tubes were attached together along the sprayer trailer frame and booms with the electrical tape provided. The 0.5 in (13 mm) tubes were small and did not interfere with the sprayer operation.

To prevent damage to the foam funnel plastic tubes during field operations, the foam funnel tubes could not be extended more than 10 in (254 mm) from the end nozzle. Therefore, the operator had to align the boom end 10 in (254 mm) from the foam mark on each successive pass.

OPERATOR SAFETY

No safety hazards were observed if normal safety precautions were adhered to. Care had to be exercised to decompress

the foam tank before opening the lid during reloading or determining the amount of fluid remaining.

OPERATOR'S MANUAL

The operator's manual was fair. The operator's manual included useful information on installation and operation. More information on foam spacing, size, quality and durability of the foam marks should be indicated to give the operator an idea of what to expect in field conditions. It is recommended that the manufacturer consider modifying the operator's manual to include information on foam spacing, size, quality and durability.

MECHANICAL HISTORY

TABLE 1 outlines the mechanical history of the Marshall Foam Marker during 79 hours of field operation, while marking about 2043 acres (827 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 right boom end foam tube leaked and was repaired at	52	1352	(547)
- the left boom end foam tube leaked and was repaired at	53	1378	(558)
- the pressure gauge indicated low and was replaced at	53	1378	(558)
- the electrical connection on the compressor shut off switch shorted	74	1924	(779)

DISCUSSION OF MECHANICAL PROBLEMS

The electrical connection at the air compressor diaphragm shut off switch shorted. Throughout the test the shut-off switch was inconsistent in starting and shutting the compressor motor off at the desired operating foam tank pressures. The new compressor shut-off switch was more consistent.

APPENDIX I SPECIFICATIONS

MAKE:	Marshall Foam Marker
MODEL:	5520
ELECTRICAL POWER REQUIREMENTS:	
- volts	12 V DC
- current draw	0.6 amps, solenoid valve 11 amps, compressor
CONTROL CONSOLE:	
- size	4 in (102 mm) O.D. and 4 in (102mm) long power and solenoid on-off switches
- controls	
MARKING SYSTEM:	
- type	foam
- marker fluid	foam concentrate and water
- tank capacity	4.25 gal (19.3 L)
MARK DELIVERY SYSTEM:	
- foam tube	
length	144 ft (43.9 m)
size	0.5 in (13 mm) I.D.
- boom end funnels	
length	8 in (203 mm)
size	3.5 in (89 mm) I.D.
- control valve	EEMCO 12V dc solenoid valve, 0.25 in (6.4 mm)

- regulating nozzle	
air	4916-20 orifice plate
fluid	4916-22 orifice plate
- strainers	
air	200 mesh
fluid	200 mesh
WIRING HARNESS:	
- power cable	8.5 ft (2.6 m)
- solenoid valve cable	12 ft (3.7 m)
COMPRESSOR:	
- make	Thomas industries Inc.
- type	piston
- size	9.5 x 4.5 x 5.5 in (241 x 114 x 140 mm)
- model	415 ADC 36112
- serial number	0388 00000671
WEIGHT:	
- console	3.3 lbs (1.4 kg)
- foam tank	52 lbs (23.6 kg) (full)
- compressor	6 lbs (2.7 kg)
- tubes	9.3 lbs (4.0 kg)
- hardware	13.4 lbs (5.9 kg)
Total	83.8 lbs (37.6 kg)
Pressure Gauge	
- make	Marsh
- range	0 - 160 psi (0 - 1100 kPa)
- size	2.5 in (64 mm)

APPENDIX II SPECIFICATIONS

MAKE:	Marshall Foam Marker
MODEL:	5520
ELECTRICAL POWER REQUIREMENTS:	
- volts	12 V dc
- current draw	0.6 amps, solenoid valve 11.2 amps, compressor
CONTROL CONSOLE:	
- size	4 in (102 mm) O.D.
- controls	power and solenoid valve on-off switches
MARKING SYSTEM:	
- type	foam
- marker	foam concentrate and water
- tank capacity	4.25 gal (19.3 L)
MARK DELIVERY SYSTEM:	
- air and foam tubes	0.25 in (6.4 mm) I.D.
- air tube length	41.8 ft (12.7 m)
- foam tube length	48.5 ft (14.8 m)
- boom end funnels	
length	8 in (203 mm)
size	3 in (76 mm)
- control valve	EEMCO 12 V DC, solenoid valve
- regulating nozzle	
air	4916-18 orifice plate
fluid	4916-20 orifice plate
- strainers	
air	200 mesh
fluid	100 mesh
WIRING HARNESS:	
- power cable	9 ft (2.7 m)
- solenoid valve cable	48.5 ft (14.8 m)
COMPRESSOR:	
- make	Thomas Industries Inc.
- type	piston
- size	8.5 x 4.5 x 5.25 in (216 x 114 x 133 mm)
- model	415 ADC36/12 - 8184
- serial number	108800142
WEIGHT:	
- console	3 lbs (1.4 kg)
- foam tank	52 lbs (23.6 kg) (full)
- compressor	6 lbs (2.7 kg)
- tubes	12 lbs (5.4 kg)
- hardware	12 lbs (5.4 kg)
Total	85 lbs (38.6 kg)
PRESSURE GAUGE	
- make	Precision Fitting Valve Company, Inc.
- range	0 - 100 psi (0 - 690 kPa)
- size	2.25 in (57 mm)

SUMMARY CHART

MARSHALL MODEL 5520

FOAM MARKER

RETAIL PRICE:	\$895.00 (July, 1989, f.o.b. Lethbridge)
QUALITY OF WORK:	
Mark Visibility	Good; mark spacings averaged 50 ft (15.2m)
Mark Durability	Good; about 1 hour
Mark Placement	Good
Quality of Foam	Good; varied with conditions
Quantity of Foam Used area marked cost	about 120 ac (49 ha) per tank 10 cents/ac (25 cents/ha)
Environmental Effects	Good; components not affected, foam had no affect on crop
EASE OF OPERATION AND ADJUSTMENT	
Refilling	Fair; premixing required
Controls	Very Good
Cleaning	Fair
Sprayer Alignment	Good; required good judgement
Mark Adjustments	Fair; orifice plate had to be changed
EASE OF INSTALLATION:	Very Good; about 3 hours, components easy to install
OPERATOR'S MANUAL:	Fair; no information on foam spacing, quality
MECHANICAL HISTORY:	compressor switch failed



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