

Evaluation Report

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Agri-Box Drill-Fill System

A Co-operative Program Between



AGRI-BOX DRILL-FILL SYSTEM

MANUFACTURER AND DISTRIBUTOR:

Agri-Box
JJEB Enterprises
Box 7
Horndean, Manitoba
R0G 0Z0

RETAIL PRICE:

\$4,875.00 (October 1984, f.o.b. Portage la Prairie, Manitoba)
16 ft (4.8 m) with telescoping downspouts and electric solenoid control valves.

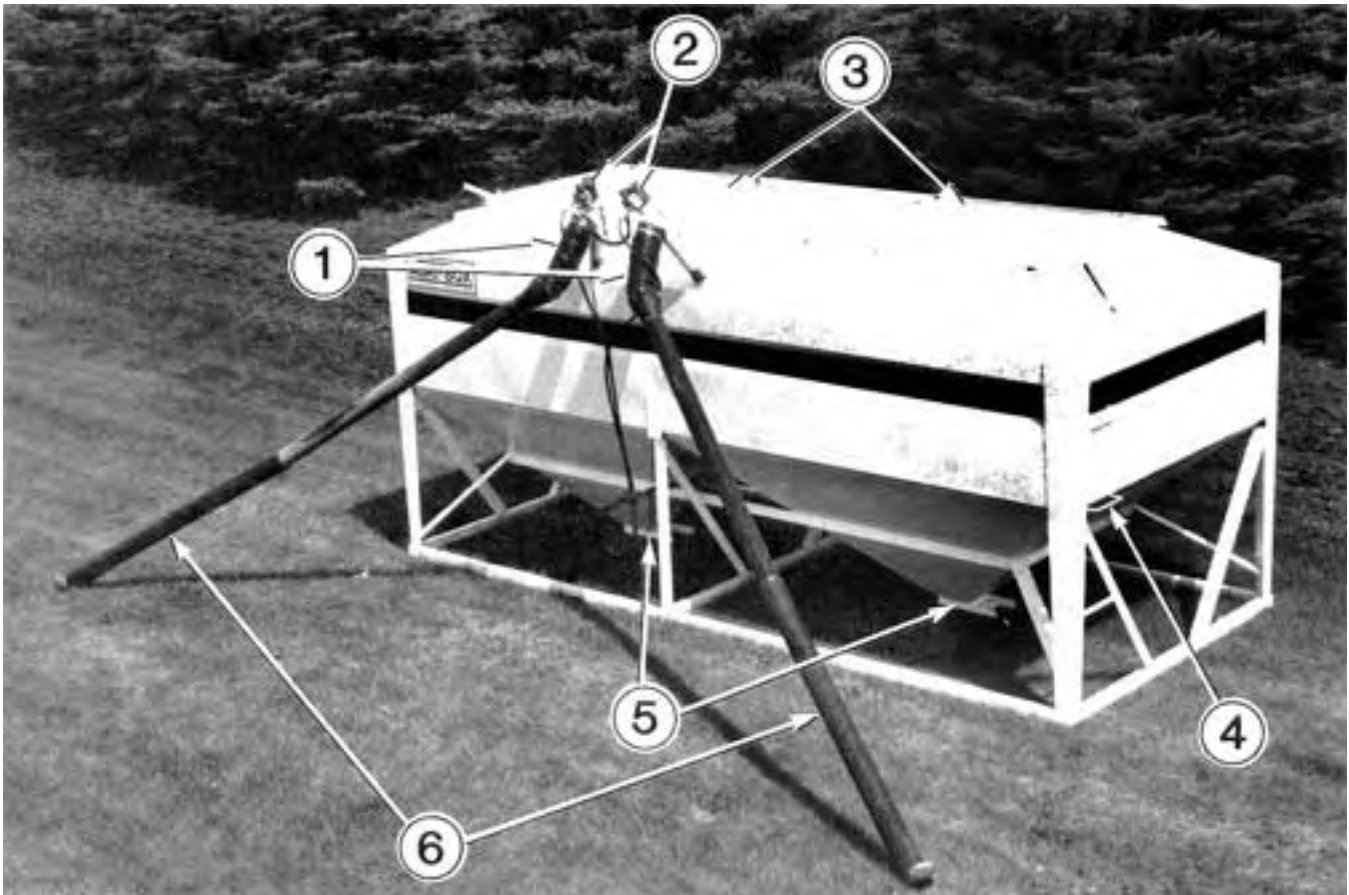


FIGURE 1. Agri-Box Drill-Fill System: (1) Flexible Couplings, (2) Orbit Motors and Control Valves, (3) Weather Tight Compartment Covers, (4) External Access Ladder, (5) Cleanouts, (6) Telescoping Downspouts.

SUMMARY

Rate of Work: Maximum capacities with single flighting were 490 bu/h (12.9 t/h) in wheat, 425 bu/h (7.7 t/h) in oats, 414 bu/h (9.9 t/h) in canola, 9.4 ton/h (8.5 t/h) in standard material, 11.3 ton/h (10.2 t/h) in fertilizer (11-51-0). Capacities were limited by hydraulic valve and orbit motor performance.

Power Requirements: The power requirements for single flighting ranged from 7.6 to 8.7 hp (5.6 to 6.5 kW) in dry grain at a flighting speed of 715 rpm.

Ease of Operation and Adjustment: The size and weight of the Agri-Box made installation impossible for one man. Once mounted on the truck, the downspout outlets were at an adequate height and reach to fill a 20 ft (6.1 m) seedbox. Final clean-out of the Agri-Box was poor¹.

Problems were encountered with fertilizer compacting in the auger tube during transport, and with solenoid valves limiting orbit motor performance.

Quality of Work: Damage in dry wheat was less than 0.03% for each pass through the drill fill. Damage to peas, using the bristle flighting was less than 0.04% for each pass.

Operator Safety: The Agri-Box was safe to use because of the exposed flighting being inside the box, and far removed from the operator. Care must be taken by the operator when using the walkway.

¹See rating chart Appendix II.

Also, care must be taken when driving with the Agri-Box fully loaded, as the centre of gravity is significantly raised, increasing the possibility of rollover.

Operator's Manual: No operator's manual was supplied with the Agri-Box.

Mechanical History: No durability problems were encountered during the test period.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications that would allow easier clean out.
2. Modifications to the hydraulic valves that will allow orbit motors to perform at full potential.
3. Modifications that would prevent fertilizer from compacting in the auger tube while transporting.
4. Providing an operator manual with instructions on operation, maintenance, assembly, hydraulic flow requirements, electrical requirements, and operator safety.

Station Manager: G.M. Omichinski

Project Technologist: R.K. Harris

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The reason for keeping a low bottom hopper gate clearance

is to keep the overall centre of gravity of the bin as low as possible, while still maintaining a high degree of slope on the hoppers. With the bottom gate removed, the small amount of material remaining in the hopper can be easily removed with a shop vacuum or a flat pan.

2. We are presently testing (in conjunction with PAMI) a new poppet valve, which would allow orbit motors to perform at full potential.
3. The anti-plug feature on our augers allow the auger flighting to be retracted into the auger tube during transport, thus preventing plugging.
4. An operator manual is now being prepared.

GENERAL DESCRIPTION

The Agri-Box Drill-Fill System is a rectangular steel box, divided into two separate compartments. The 280 ft³ (7.9 m³) compartment holds 220 bu of seed, the other 215 ft³ (6.0 m³) compartment holds 6.5 ton (5.9 tonne) of fertilizer. The box is supported on an external frame, fabricated from angular steel and rectangular tubing. Each compartment has a hopper bottom with a slide gate for a cleanout, and a weather tight rolling lid. Each compartment is equipped with a 5 in (127 mm) hydraulically powered auger, and an internal access ladder. The Agri-Box evaluated was the 16' (4.88 m) version.

Two optional double and bristle auger flightings were provided. Bristle flighting is intended for conveying large seeds such as corn, peas, and sunflowers. Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Agri-Box was operated for about 15 hours in the laboratory and field, while conveying wheat, oats, canola, peas and fertilizer (11-51-0)². It was also operated in a standard test material³ for about one hour. It was evaluated for rate of work, power requirements, ease of operation and adjustment, quality of work, operator safety and suitability of the operator manual.

Capacity and power requirement tests were performed on optional and standard flightings. In addition, anti-plugging feature tests (FIGURE 2) were carried out on the augers and moisture resistance tests on the covers of compartments.



FIGURE 2. Anti-plugging Augers.

RESULTS AND DISCUSSIONS

RATE OF WORK

Capacity: Although orbit motors are rated at 770 rpm (continuous) 15 gpm (US) (56.7 L/min) flowrate, this optimum performance of the orbit motors could not be achieved without the adjacent motor beginning to creep, due to some undetermined fault in the solenoid valves. Also, the rated levels of performance were not normally possible with a grain truck hydraulic system,

on which the Agri-Box Drill-Fill system is intended to be operated. Maximum capacities were, therefore, determined at the point where the adjacent motor began to creep. The results are presented in TABLES 1 & 2 for single and double flighting. Capacities at a flow rate of 10 gpm (L/s) (38 L/min) (typical for a truck hydraulic system) are presented in TABLE 3.

TABLE 1. Maximum Capacity -- Single Flighting

Material	Capacity		Specific Capacity		rpm	US gpm	L/min	hp	kW
	bu/h	t/h	ton/hp-h	t/kW-h					
Wheat	490	12.5	1.6	2.9	717	13.9	52.5	8.7	6.5
Oats	425	7.1	1.0	1.2	711	13.8	52.1	8.1	6.0
Canola	414	9.9	1.4	1.7	719	14.0	52.9	7.6	5.7
Standard Material Fertilizer (11-51-0)	ton/h	8.5	1.2	1.5	710	13.8	52.1	7.7	5.8
	11.3	10.2	1.5	1.8	701	13.6	51.4	7.7	5.8

TABLE 2. Maximum Capacity -- Double Flighting

Material	Capacity		Specific Capacity		rpm	US gpm	L/min	hp	kW
	bu/h	t/h	ton/hp-h	t/kW-h					
Wheat	518	13.7	2.3	2.7	725	12.0	45.4	6.5	4.9
Oats	498	8.4	1.1	1.3	660	12.6	48.3	6.8	5.1
Canola	480	11.5	2.5	3.0	552	10.7	40.4	5.1	3.8
Standard Material Fertilizer (11-51-0)	ton/h	9.4	1.4	1.7	700	13.6	51.4	7.3	5.5
	No capacity tests were run with fertilizer, using this flighting								

TABLE 3. Capacities at 10 gpm (US) (38 L/min) 525 rpm

Material	Single Flighting		Double Flighting		Power Required Single Flighting		Time To Fill A 25 bu Seed Box (minutes)	
	bu/h	t/h	bu/h	t/h	hp	kW	single flt.	double flt.
Wheat	430	11.3	518	13.7	5.3	4.0	3.5	2.9
Oats	395	6.6	496	8.4	5.4	4.0	3.8	3.0
Canola	360	8.6	480	11.5	5.1	3.8	4.1	3.1
Peas (Bristle Flighting)	215	6.2						
Standard Material Fertilizer (11-51-0)	ton/h	7.9	10.4	9.5	4.5	3.4		
	8.7	9.1			6.0	4.5	5.6	

The maximum capacities (limited by motor creep) for single flighting were: 490 bu/h (12.9 t/h) in wheat, 425 bu/h (7.1 t/h) in oats, 414 bu/h (9.9 t/h) in canola, 9.4 ton/h (8.5 t/h) in standard material, 11.3 ton/h (10.2 t/h) in fertilizer (11-51-0). The use of the optional double flighting increased capacities by 20-30% for materials other than fertilizer.

POWER REQUIREMENTS

TABLES 1, 2 and 3 gives the power requirements for the Agri-Box in wheat, oats, canola, standard material, and fertilizer. Power requirements at maximum capacity in grain ranged from 7.6 to 8.7 hp (5.7 to 6.5 kW) for single flighting, 5.1 to 6.8 hp (3.8 to 5.1 kW) for double flighting, and 5.1 to 5.4 hp (3.8 to 4.0 kW) for single flighting at oil flowrates of 10 gpm (US) (38 L/min).

Hydraulic Requirements: The manufacturer recommends a system flow rate of at least 8 gal (US)/min (30.3 L/min) with a continuous pressure of 1500 psi (30.3 MPa). The flighting was connected directly to the shaft of the hydraulic motor, making the flighting speed dependent upon the flow of hydraulic fluid through the motor. Typical truck hydraulic systems have a flow rate of 10 gpm (38 L/min).

EASE OF OPERATION AND ADJUSTMENT

Installation: A minimum of two people were required to install the Agri-Box complete with hydraulic and electrical connections (two hours). A front-end loader and an overhead crane were required to raise, and push the Agri-Box into the box of a conventional grain truck. General rating of installation was good.

Operation: Filling the Agri-Box with bulk seed and fertilizer was easily accomplished, using an external auger. The telescoping downspout and flexible couplings of the Agri-Box made filling a seed

²See Appendix III for test material densities.

³The standard test material is a high density (48.9 lb/bu) granular polyethylene. The material is consistent and not subject to change in physical properties.

box easy. The electrical control switches located in the handles on the downspouts were easy to use and did not require constant pressure to keep them in the "on" position. There was ample wire supplied to connect to most truck batteries. General rating on the filling operation was very good.

Final clean-out of the Agri-Box was difficult. There was very little space between the floor of the truck box and the slide gate in the bottom of the compartment hoppers. (FIGURE 3) It is recommended that the manufacturer consider modifications to improve clean-out.

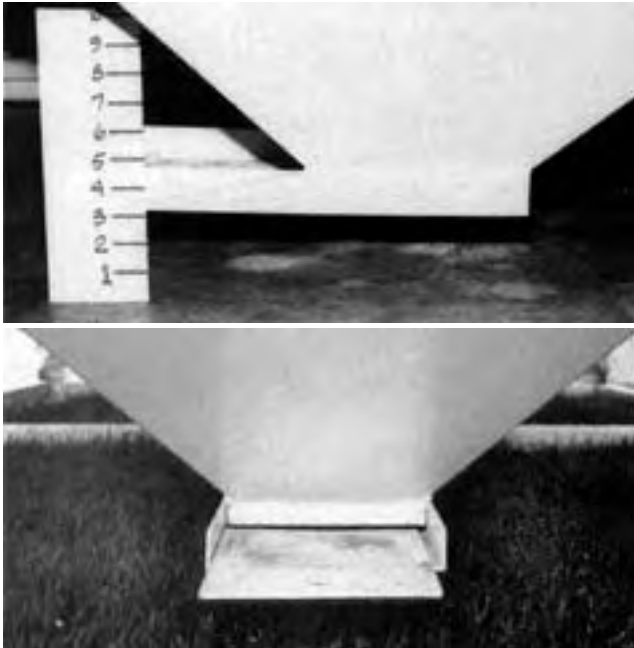


FIGURE 3. Cleanout Clearance.

When a loaded Agri-Box was transported, fertilizer compacted in the auger tube, rendering it inoperable. The flighting had to be drawn up inside the tube in order to free it. It is recommended that modifications be made to prevent fertilizer from compacting in the auger tube while transporting.

In addition, auger orbit motors could not be run at full potential, due to a fault in the solenoid valves that controlled the flow of oil between the two motors. This problem occurred when the orbit motors were run at high flow rates, 11 to 15 gpm (US) (41.6 to 56.7 L/min). The performance of the motor being used was reduced by oil leaking past the solenoid valve. This condition caused the adjacent motor, which normally should remain idle, to creep when the control switch was in the "off" position.

It is recommended that the manufacturer consider modifications to the hydraulic valves that will allow orbit motors to perform at their full potential.

Testing of the anti-plugging augers consisted of plugging the telescoping downspouts, and running the augers. The anti-plugging device performed as designed, allowing material to spill from the top of the auger tube, preventing jamming of the flighting.

Moisture resistance tests on the compartment covers, consisted of running water over the covers and checking for leaks. No leaks were detected.

Spout Reach: The length of seed box that can be filled using the telescoping downspout of the Agri-Box depends upon the distance the grain drill or seedbox is to the Agri-Box. The downspout should be held at an angle of at least 20° for dry seed or fertilizer to flow, and greater than 20° for treated seed. A 20 ft (6.1 m) seedbox was easily filled. General rating on spout reach was very good.

QUALITY OF WORK

Grain Damage: Damage in dry wheat was less than 0.03% for each pass through the drill fill. This is considered insignificant. The moisture content of the wheat was 13.1%. Grain at higher moisture contents would have less damage.

Bristle flighting (FIGURE 4) is used to convey large seeds such as peas, corn, soybeans, sunflowers, etc. Damage to Century peas was 27% using single steel flighting and 0.04% when using the

bristle flighting.



FIGURE 4. Bristle Flighting.

OPERATOR SAFETY

The Agri-Box was safe to operate. Care should be taken when using the built in ladders on the outside of the box and inside the compartments.

Also, care should be taken when traversing the walkway on top of the Agri-Box.

Because of additional overall height when the Agri-Box is mounted on a truck (approximately 24 in (610 mm), the centre of gravity is significantly raised when loaded, and great care is required when turning corners.

The flighting guard met the requirements of ASAE S361.2T Safety for Agricultural Auger Conveying Equipment, Dec. 1983.

OPERATOR'S MANUAL

No operator's manual was supplied with the Agri-Box. It is recommended that the manufacturer provide an operator's manual with instructions on operation, maintenance, assembly, hydraulic flow requirements, electrical requirements, and operator safety.

MECHANICAL HISTORY

The Agri-Box was operated for about 15 hours in the lab and field. No mechanical problems were encountered.

**APPENDIX I
SPECIFICATIONS**

MAKE:	Agri-Box
MODEL:	16 ft (4.8 m)
DIMENSIONS:	
-- overall length	16.0 ft (4.8 m)
-- width	17.9 ft (5.4 m)
-- height	8.7 ft (2.6 m)
-- top of augers	8.7 ft (2.6 m)
-- top of box	7.7 ft (2.3 m)
TOTAL WEIGHT:	2500 lb (1136 kg)
AUGER TUBE: A REAR (grain)	
-- outside diameter	5.0 in (127 mm)
-- inside diameter	4.7 in (120 mm)
-- length	9.0 ft (2.7 m)
-- material thickness	0.125 in (3.1 mm)
-- inlet length	11.0 in (280 mm)
-- outlet	
-size (diameter)	5.0 in (127 mm)
-shape	Round
AUGER TUBE: B FRONT (Fertilizer)	
-- outside diameter	5.0 in (127 mm)
-- inside diameter	4.7 in (120 mm)
-- length	8.3 ft (2.5 m)
-- material thickness	0.125 in (3.1 mm)
-- inlet length	11.0 in (280 mm)
-- outlet	
-size (diameter)	5.0 in (127 mm)
-shape	Round
HOPPERS:	
-- volume	
-grain	220 bu (8.0 m ³)
-fertilizer (11-48-0)	6.5 ton (6.2 m ³)
-- shape	Rectangular with added bottoms
-- finish	Hoppers are sandblasted and painted inside and out with anti-corrosive epoxy paint.

**APPENDIX II
MACHINE RATINGS**

The following rating scale is used in Machinery Institute Evaluation Reports:

Excellent	Fair	Poor
Very Good		
Good	Unsatisfactory	

APPENDIX III

Densities of Test Crops and Materials:		
Wheat	582 lb/bu	(264 kg/bu)
Canola	527 lb/bu	(239 kg/bu)
Oats	370 lb/bu	(168 kg/bu)
Peas	632 lb/bu	(287 kg/bu)
Standard Material	489 lb/bu	(222 kg/bu)
Fertilizer (11-51-0)	600 lb/ft ³	(27 kg/ft ³)

SUMMARY CHART

AGRI-BOX DRILL-FILL SYSTEM 16 ft

RETAIL PRICE:	\$4,875.00 (October 1984, f.o.b. Portage la Prairie)
EASE OF OPERATION AND ADJUSTMENT:	
Installation	Good (two people, two hours)
Filling	Very Good
Transport	Good (when fully loaded, fertilizer tended to compact in auger tube preventing operation)
Cleanout	Poor (difficult and time consuming)
Spout Reach	Very Good
RATE OF WORK:	
Capacity	Limited by faulty solenoid valves
Wheat (dry)	490 bu/h (12.9 t/h)
Standard Material	9.4 tons/hr (8.5 t/h)
POWER REQUIREMENTS:	
Dry Grain	7.7 to 8.6 hp (5.8 to 6.4 kW)
QUALITY OF WORK:	
Dry Wheat	Less than 0.03% damage per pass
OPERATOR SAFETY:	
	Guarded in accordance with ASAE Safety Standards
OPERATOR'S MANUAL:	
	Not supplied
MECHANICAL HISTORY:	
	No mechanical failures were encountered



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