

Evaluation Report

651



Flexi-coil 5000 Air Drill

A Co-operative Program Between



FLEXI-COIL 5000 AIR DRILL

MANUFACTURER AND DISTRIBUTOR:

Flexi-coil Ltd.
1000 71 Street E.
P. O. Box 1928
Saskatoon, Saskatchewan S7K 3S5
Telephone: (306) 934-3500

RETAIL PRICE: \$42,402, (May 1991, f.o.b. Lethbridge) for 39 foot 5000 Flexi-coil drill complete with 7.2" spacing, floating hoe opener and set-up.

\$3,069 for dual endmarkers complete with cycling valve, hydraulic lines and set-up.

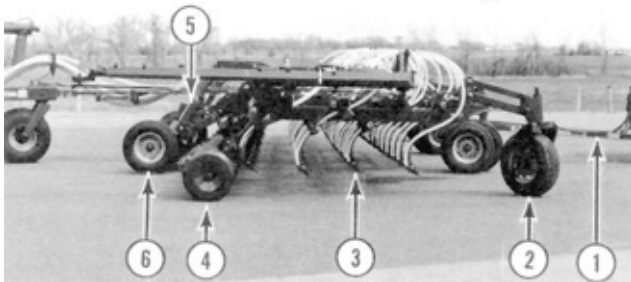


FIGURE 1. Flexi-coil 5000 Air Drill. (1) Hitch, (2) Castor Wheels, (3) Hoe Openers, (4) Press Wheels, (5) Hydraulic Depth Control Cylinders and (6) Transport Wheels.

SUMMARY

QUALITY OF WORK:

Penetration of the Flexi-coil 5000 with the adjustable floating hoes was very good. The openers penetrated hard soils and shallow tilled fields. Optional spacer blocks were available to lower those openers following in tire tracks.

The seed and fertilizer placement was very good. Seed and fertilizer were placed together in the furrows. Band width of the placed seed and fertilizer depended on the fan speed of the pneumatic delivery system. Variation in seed and fertilizer depth remained uniform when seeding in either tilled or untilled soil.

Soil finishing was very good. The majority of the straw was left on the surface with some remaining upright when operating in untilled stubble conditions. The packing force was adequate for the soils and conditions encountered during the test.

Trash clearance was very good. The four rows of hoe openers allowed good trash flow but plugged occasionally in heavy, wet straw conditions.

The quality of the mark left by the marking system was fair. The mark left in untilled fields was usually not visible from the tractor cab. The disc on the marker was not aggressive enough to make a visible mark in trash or untilled field conditions.

EASE OF OPERATION AND ADJUSTMENT:

Ease of performing routine maintenance on the Flexi-coil 5000 was good. Most grease fittings were accessible without much difficulty. One person required 30 minutes to service the 71 weekly grease fittings.

Ease of transporting was very good. Caution was required when transporting the unit because of the high transport height.

The unit towed well at speeds up to 18 mph (29 km/h). The test unit as equipped with endmarkers required the use of three sets of remote hydraulics. The short hitch allowed the unit to trail directly behind the tractor with very responsive turning.

Ease of operating and adjusting the marking system was good. The unit was equipped with an end marker on each side. The markers were operated from the tractor using a remote hydraulic circuit.

Ease of setting the seeding depth was very good. The seeding depth was controlled by the two hydraulic cylinders

located on the back of the unit. Levelling the frame initially, was time consuming.

POWER REQUIREMENTS:

Overall tractor size needed to pull the test unit at normal seeding depths and at 5 mph (8 km/h) varied from 193 pto hp (144 pto kW) to 254 pto hp (190 pto kW).

OPERATOR SAFETY:

The Flexi-coil 5000 Air Drill was safe to operate when normal safety precautions were observed. Accommodations for a safety tow chain were provided but the chain was not provided. The manufacturer offers the chain as an option.

OPERATOR'S MANUAL:

The operator's manuals were very good. A separate manual for the Endmarker was provided. The manuals were clearly written, with photographs and illustrations for explanations.

MECHANICAL HISTORY:

The hoe point openers were worn out after 2130 ac (850 ha) or 33 ac (13 ha) per point.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing a safety tow chain as standard equipment.
2. Modifying the marking system so a visible mark is made in all field conditions.

THE MANUFACTURER STATES THAT:

1. Consideration is being given to provide the safety tow chain as standard equipment.
2. The end marker has been improved to provide a visible mark in all normal field conditions. The disc is now a serrated disc to provide better penetration. The disc depth is controlled by a polyurethane "gauge wheel" to give adequate, but not excessive penetration in a variety of soil and trash conditions.

THE MANUFACTURER ALSO STATES THAT:

1. A new valve has been added to the dual markers to provide proper cycling of the markers at headlands.
2. Some of the zerk type greaseable bushings have been replaced with greaseless bushings, thus decreasing the time required to grease the machine.
3. The depth adjustment apparatus as shown in FIGURE 9 has been offset to allow easy operator access even when the 5000 is used in conjunction with a tow-behind air seeder.
4. Long wearing, hardened alloy tips are now available for the floating hoe option on the 5000.

GENERAL DESCRIPTION

The Flexi-coil 5000 Air Drill is a trailing three or five section four row hoe drill with either 7.2, 9.0 or 12.0 in (183, 229 or 305 mm) opener spacing. The drill can be operated with any air delivery system. Five different operating widths are available from 27 to 57 ft (8.2 to 17.4 m). The seed and fertilizer are placed in the furrow made by the opener and packed by individual gang press wheels.

The seeding depth is controlled by two hydraulic cylinders and a valve located on the rear of the drill. The cylinders rotate a rockshaft on the rear of the unit. The rockshaft is connected to the packers which support the back of the drill. The rockshaft also controls a series of parallel linkages and castor wheels which support the front of the drill. The castor wheels on the main frame are dual and single on the wings.

The drill is available with either adjustable floating hoe or cultivator style shanks.

The centre and wing sections consist of various frame members connected with flexible ball joints and/or polyurethane spacers. The wings fold into transport with two hydraulic cylinders connected in parallel.

The transport wheels at the back of the drill are operated in the field by the rockshaft and by the depth control cylinders. The unit is put into full transport position with two additional smaller hydraulic cylinders. These smaller hydraulic cylinders are run off the same hydraulic circuit as the wing lift.

The test machine was a 39 ft (11.9 m), three section unit with 65 adjustable floating hoe shanks. The Flexi-coil 5000 Air Drill was used with a Flexi-coil 1610 Air Seeder during the test. Optional equipment on the test unit included endmarkers on each side which hydraulically folded back for transport. FIGURE 1 shows the location of major components. Detailed specifications are given in APPENDIX 1.

SCOPE OF TEST

The Flexi-coil 5000 Air Drill was operated in the field conditions shown in TABLE 1 for 98 hours while seeding 2130 ac (850 ha). The unit was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual.

The machine evaluated by the AFMRC was configured as described in the General Description, FIGURE 1, and the Specifications section in APPENDIX I of this report. The manufacturer has built different configurations of this machine before and after the AFMRC tests. Therefore, when using this report, check that the machine under consideration is the same as the one reported here. If differences exist, assistance can be obtained from the AFMRC or the manufacturer to determine changes in performance.

TABLE 1. Operating Conditions

MATERIAL	SOIL TYPE AND CONDITION	STONE CONDITIONS	FIELD AREA ac (ha)	HOURS
Wheat	Silt Loam Secondary	Stone Free	490 (196)	22
Barley	Silt Loam Secondary	Stone Free	640 (256)	28
Barley	Silt Loam Secondary	Stone Free	275 (110)	12
Barley	Loam Secondary	Occasional Stones	285 (114)	14
Barley	Loam Primary	Occasional Stones	160 (64)	8
Canary	Loam Secondary	Occasional Stones	160 (64)	8
Flax	Loam Secondary	Occasional Stones	120 (48)	6
TOTALS			2130 (852)	98

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration of the Flexi-coil 5000 with the adjustable floating hoes was very good. Several of the fields encountered during the test contained areas of hard soil or were prepared at a shallow tillage depth. For hard pan conditions or operations such as deep banding the cultivator shanks are recommended.

Penetration was uniform across the entire width provided the unit was properly levelled. The front castor wheels and packers provided adequate support for the drill frame. The flexible frame allowed the drill to follow rolling field contours very well.

The floating hoe opener (FIGURE 2) consisted of a compression spring, shank, frame mount and hoe point opener. The compression spring force was varied by moving the position of the top of the spring. Four different positions were available. Each spring position provided a different force deflection curve as shown in FIGURE 3. The openers were operated in positions #1 and #2 during the test.

Optional spacer blocks were available to lower those openers following in tire tracks.

Seed and Fertilizer Placement: The seed and fertilizer placement of the Flexi-coil 5000 was very good. The seed and fertilizer were placed together in the furrows. The Flexi-coil 5000 was equipped

with a tube type delivery boot located directly behind the hoe opener. Band width of the seed and fertilizer depended on the fan speed of the pneumatic delivery system. When the fan was operated at the recommended speed, the band widths of the rows were an average of 1.9 in (48 mm). The seed and fertilizer were usually placed in a slightly wider band at higher fan speeds.

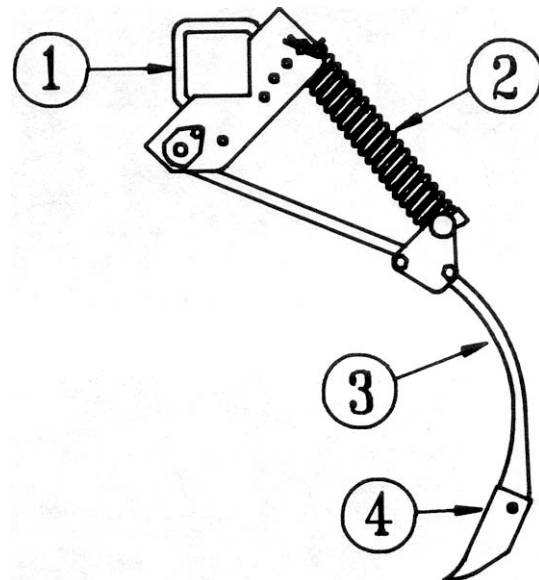


FIGURE 2. Floating Hoe Opener Assembly: (1) Frame Mount, (2) Compression Spring, (3) Shank and (4) Hoe Point Opener.

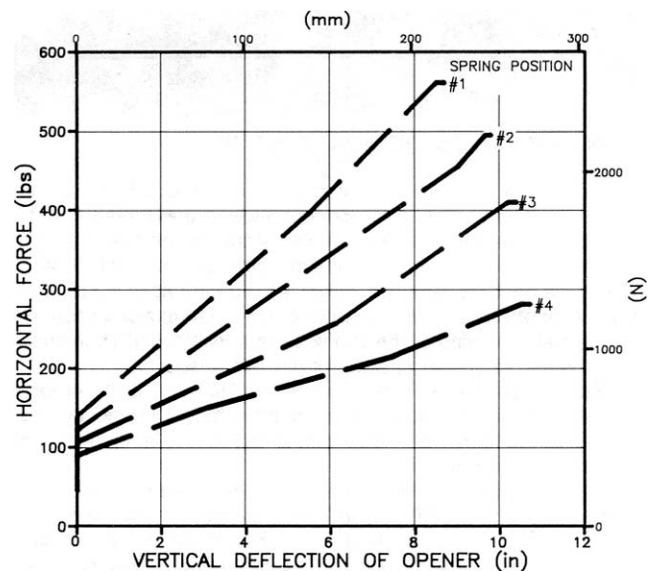


FIGURE 3. Force Deflection Curve for the Floating Hoe Opener.

The Flexi-coil 5000 was stable but skewed on steep hillsides with loose tilled soil. This was typical of most seeding implements. The effect on the seed placement was larger variations in row spacings.

Variation in seed and fertilizer depth was uniform when seeding in either tilled or untilled soil. For example, at an average seed depth of 2.0 in (51 mm), most seeds were placed within 0.6 in (16 mm) of the average seed depth. High operating speeds caused the furrows for the back row of openers to have a slightly shallower seed depth. This was typical of most hoe drills.

Soil Finishing: Soil finishing of the Flexi-coil 5000 was very good. FIGURE 4 shows the soil surface after seeding into an untilled wheat stubble field. The majority of the straw was left on the surface with some remaining upright. FIGURE 5 shows the soil surface after seeding into a previously tilled field. Ridge depths left by the press wheels ranged from 1.0 to 2.5 in (25 to 64 mm), depending on soil conditions. The packing force was adequate for the soils and conditions encountered during the test.



FIGURE 4. Soil Surface After Seeding into an Untilled Wheat Stubble Field.



FIGURE 5. Soil Surface After Seeding into a Tilled Field.

Trash Clearance: Trash clearance of the Flexi-Coil 5000 was very good. The four rows of hoe openers allowed good trash flow but plugged occasionally in heavy wet straw conditions. Plugging occurred at random throughout the drill but more often at two places where the openers were spaced 22 in (560 mm) apart on the front row. Other openers were spaced at 29 in (740 mm) along each row. A schematic drawing of the shank pattern in APPENDIX III shows the variation in opener spacing of the centre section.

Stony Conditions: Operation of the Flexi-coil 5000 in stony conditions was very good. Maximum lift height of the floating hoe opener varied from 11.5 in (292 mm) to 15.5 in (394 mm) depending on the trip spring position.

Marking System: The quality of the mark left by the marking system was fair. FIGURES 6 and 7 show the mark left by the marking system in tilled and untilled field conditions with maximum disc angle and maximum weight on the disc. The mark left in untilled fields was usually not visible from the tractor cab. The mark left in tilled fields was visible from the tractor cab due to the difference in color of moist and dry soil. The disc on the marker was not aggressive enough, to make a visible mark in heavy straw or untilled field conditions. It is recommended that the manufacturer consider modifying the marking system so a visible mark is made in all field conditions.

EASE OF OPERATION AND ADJUSTMENT

Maintenance: Ease of performing routine maintenance on the Flexi-coil 5000 was good. Most grease fittings were accessible without much difficulty. Grease fittings were provided for all the wheel hubs. The wheel hubs required servicing every 200 hours. The press wheel mounts and the endmarkers required servicing annually. All the other grease fittings required servicing weekly or every 50 hours. A service schedule was provided in the owner's manual. One person required 30 minutes to service the 71 weekly grease fittings.

Two people required two hours to remove and replace the 65 hoe opener points. The points were held on the shanks by a single bolt and nut.



FIGURE 6. Mark Left by Endmarker in a Tilled Field.



FIGURE 7. Mark Left by Till Mark Endmarker in an Untilled Field.

Transporting: Ease of transporting the Flexi-coil 5000 was very good. Less than five minutes were required to place the unit in transport position (FIGURE 8). Transport locks were not necessary for the wings because the wings leaned over centre at the middle. Locks were provided for the markers to prevent them from extending when the wings were in transport position. The locks engaged automatically.



FIGURE 8. Transport Position. (Shown without endmarkers)

Safety struts were provided for the depth and transport hydraulic cylinders. Weight should not be carried on the depth cylinder safety struts during transport because the frame would not be allowed to flex. These struts were a safety back-up in case the hydraulics failed during transport or when the operator was working under the unit to change the hoe points.

Transport width was 19 ft (5.8 m) and transport height was 17.3 ft (5.3 m). Caution was required when transporting the unit because of the high transport height. The unit towed well at speeds up to 18 mph (29 km/h). Minimum ground clearance during transport was 4.0 in (102 mm). This clearance occurred at the press wheels and was adequate during the test. Ground clearance for the hoe openers

during transport was 10 in (254 mm). Wheel tread width was 15 ft (4.6 m), which made the unit stable during transport.

Hitching to the Flexi-coil 5000 was easy because of the floating hitch. Access to the hitch jack was adequate. The test unit as equipped with endmarkers required the use of three sets of remote hydraulics. The hydraulics were used to control the operating depth, lift the wings and engage the marking system.

The short hitch allowed the unit to trail directly behind the tractor with very responsive turning.

Marking System: Ease of operating and adjusting the marking system was good. The unit was equipped with an endmarker on each side. The markers were operated from the tractor using a remote hydraulic. A three position manual hydraulic valve located on the drill allowed the marking system to be used in two different ways. One position on the valve allowed both markers to fold in and out together so either both markers were used or none at all. The second position allowed either marker to be out while the opposite marker was folded in. The third position cut off all hydraulic flow from the tractor to the markers. This marker control system was suitable for large fields which were worked back and forth so the markers could be alternated.

The marker had four different adjustments. The disc angle was varied by loosening two bolts and rotating the disc in the slots. The weight on the disc was varied by adjusting the tension in the counter-balance spring. Changing the length of chain or sliding the spring anchor adjusted the spring tension. The length of the marker was adjusted by loosening two bolts and sliding the marker tube within the swing tube. The maximum length of the markers was 20 ft (6.1 m). The trip back force for the markers was set by two adjustments. A bolt and jam nut adjusted the over centre trip force. An eyebolt and locknut set the spring tension or the speed at which the boom returned to position after tripping.

Depth Adjustment: Ease of setting the seeding depth was very good. The seeding depth was controlled by the two hydraulic cylinders located on the back of the unit. Depth adjustment was accomplished by turning the adjustor crank on the depth stop arm. This changed the point of engagement of the hydraulic shut off valve (FIGURE 9). Access to this assembly was hampered by the hitch for the tow-behind air seeder. This would not occur with a tow-between air seeder.

Levelling the frame initially was time consuming. Four adjustments on the front and four on the back controlled the levelling of the frame. The centre section was levelled first and measurements were taken from the frame to the ground. Levelling the wing sections was easier because they could be sighted along the frame. Each adjustment point had two adjustor bolts except the dual castors on the front of the centre section which had one. FIGURES 10 and 11 show a levelling adjustment for the back of the drill and a wing section front castor.

The test unit required releveling once during the test when an untilled stubble field was seeded.



FIGURE 9. Depth Adjustment.

POWER REQUIREMENTS

Draft Characteristics: Draft (drawbar pull) requirements depended on previous field preparation, soil texture, soil moisture content and ground speed.

Average draft, at a normal seeding depth and at 5 mph (8 km/h), in silty clay loam soil for the 39 ft (11.9 m) drill unit tested, ranged from 8020 lb (35.7 kN) to 10600 lb (47.1 kN).

Average draft of the Flexi-coil 1610 tank used during the test when full of wheat ranged from 680 lb (3.0 kN) to 1030 lb (4.6 kN).



FIGURE 10. A Levelling Adjustment for the Back of the Drill.



FIGURE 11. Levelling Adjustment on the Wing Section Front Castor.

Tractor Size: FIGURE 12 shows the power take-off horsepower requirements per foot of drill width for varying seed depths at 5 mph (8 km/h). Requirements varied from 2.6 hp/ft (6.4 kW/m) at a 0.5 in (13 mm) seed depth to 7.3 hp/ft (18.0 kW/m) at a 3.5 in (89 mm) seed depth. Therefore, overall tractor size needed to pull the Flexi-coil 5000 Air Drill 39 ft (11.9 m) test unit at normal seeding depths and at 5 mph (8 km/h) varied from 193 pro hp (144 pto kW) to 254 pto hp (190 pto kW). Additional tractor size needed to pull the Flexi-coil 1610 tank used during the test when full of wheat at 5 mph (8 km/h) ranged from 16 pto hp (12 pto kW) to 25 pto hp (19 pto kW). These tractor sizes have been adjusted to include tractive efficiency and represent a tractor operating at 80 percent of maximum power take-off ratings as determined by Nebraska tests or as presented by the tractor manufacturer. The tractor sizes given will have ample power reserve to operate in the stated conditions.

OPERATOR SAFETY

The Flexi-coil 5000 Air Drill was safe to operate when normal safety precautions were observed. Caution also had to be used when adjusting or setting the marker. Accommodations for a safety tow chain were provided but the chain was not provided. The manufacturer offers the chain as an option. It is recommended the manufacturer consider providing a safety tow chain as standard equipment. A slow moving vehicle sign was provided and should be used on the Flexi-coil 5000 if used with a tow-between air seeder. Safety struts were provided for the depth and transport hydraulic cylinders in case of a hydraulic failure.

Tire loads did not exceed the maximum load ratings for transport speeds up to 25 mph (40 km/h).

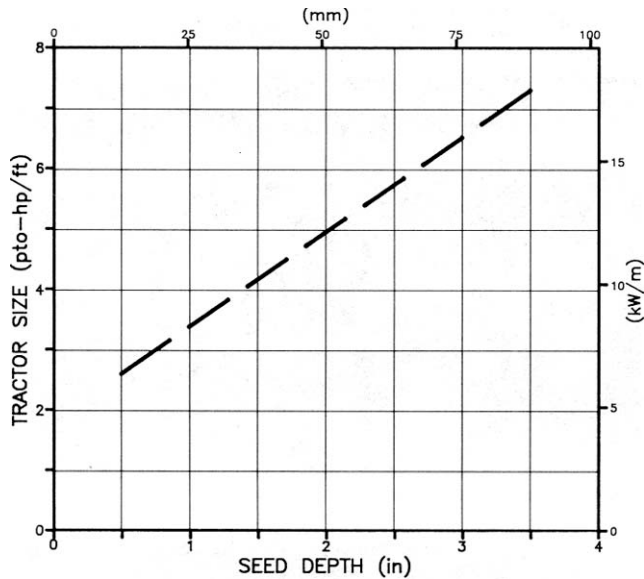


FIGURE 12. Average Horsepower Requirements at 5 mph (8 km/h).

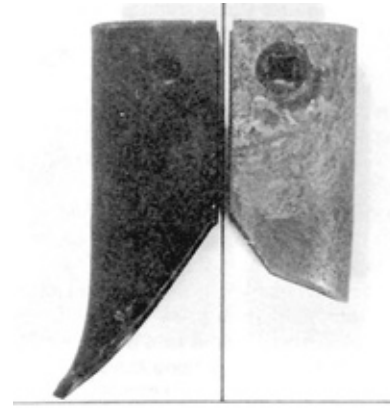


FIGURE 13. Hoe Point Wear at End of Test.

OPERATOR'S MANUAL

The operator's manuals for the Flexi-coil 5000 were very good. Information on safety, operation, maintenance, trouble shooting and adjustments was contained in the operator's manual. A separate manual for the Endmarker provided information on safety, operation, adjustments and assembly of the marker. A parts manual was not provided. The manuals were clearly written, with photographs and illustrations for explanations.

MECHANICAL HISTORY

The Flexi-coil 5000 was operated for 98 hours while seeding 2130 ac (852 ha). The intent of the test was evaluation of functional performance and an extended durability evaluation was not conducted. TABLE 2 outlines the mechanical problems that did occur during the functional testing.

TABLE 2. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA	
		ac	(ha)
-- the fourth row, left outside shank was bent to the side and repaired at		1690	(676)
-- disc on the left side end marker was bent at			end of test
-- replaced hoe points due to wear at			end of test
-- checkvalve for the left side end marker failed at			end of test

DISCUSSION OF MECHANICAL PROBLEMS

Bent Shank: The fourth row, left outside shank was bent to the side during the test. Possible reasons for the bent shank were turning in hard soil or rock damage.

Marking System: The checkvalve for the left side endmarker did not maintain hydraulic pressure. This allowed the marker to sway in and out. The disc on the left side endmarker was slightly bent at the end of the test due to operation throughout the test. Possible reasons for the damage to the disc were turning corners, rocks or swinging the marker out to field position.

Hoe Point Wear: FIGURE 13 shows the average wear of the hoe point openers at the end of the test. The points were worn out after 2130 ac (850 ha) or 33 ac (13 ha) per point. Cost of the replacement hoe point was \$4.41.

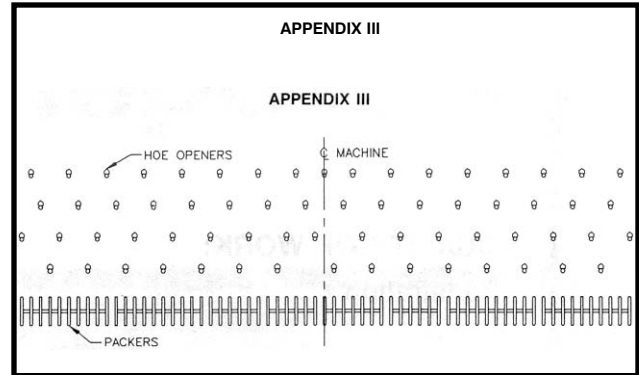
**APPENDIX I
SPECIFICATIONS**

MAKE:	Flexi-coil	
MODEL:	5000 Airdrill	
SERIAL NUMBER:	AD A0000 - K038307	
MANUFACTURER:	Flexi-coil Ltd. 1000 71 STREET E. P. O. Box 1928 Saskatoon, Saskatchewan S7K 3S5	
DIMENSIONS OF TEST UNIT:	Field Position	Transport Position
- height	6.2 ft (1.9 m)	17.3 ft (5.3 m)
- length	28.0 ft (8.5 m)	26.8 ft (8.2 m)
- width	40.3 ft (12.2 m)	19.0 ft (5.8 m)
- effective seeding width	39.0 ft (11.9 m)	
- transport ground clearance		
- packers		4.0 in (102.0 mm)
- shanks		10.0 in (254.0 mm)
- wheel tread		15.0 ft (4.6 m)
OPENERS:	adjustable floating hoe wrap around	
- type	wrap around	
- point	1.6 in (41 mm)	
- point width	65	
- number	7.2 in (183 mm)	
- spacing	30.5 in (775 mm) (frame to point)	
- vertical clearance	4	
- number of rows	24.0 in (610 mm)	
- distance between rows	0.75 x 2.0 in (19 x 51 mm)	
- shank cross section	0.44 x 2.0 in (11 x 51 mm)	
- opener bolt size		
PRESS WHEELS:	v-shaped steel	
- type	22 in (559 mm)	
- diameter	2.25 in (57.2 mm)	
- width	65, two sets of 10 on each wing, three sets of 6 and one set of 7 on the centre section.	
- number	7.2 in (183 mm)	
- spacing		
HITCH:	floating	
DEPTH CONTROL:	hydraulic cylinders with shut-off valve	
FRAME:	3	
- number of sections	4.0 in (102 mm) square tubing	
- cross sections		
CASTOR WHEELS:	6, two sets of walking beams on centre section, singles on the wing sections.	
- number	9 - 15LT 6-ply rating on centre section	
	9.5L - 15 6-ply rating on the wing sections	
- tire size		
TRANSPORT WHEELS:	4	
- number	two sets of duals with walking beams	
- type	9-15LT6-ply	
- tire size		
LEVELLING:	adjustment bolts on the packers and castors	
TRANSPORT LOCK:	safety struts for the hydraulic cylinders on the transport wheels	
WEIGHTS:	Field Position	Transport Position
- castors	6640 lb (3010 kg)	8100 lb (3670 kg)
- transport wheels	--	9410 lb (4270 kg)
- packers	10870 lb (4930 kg)	--
- hitch	280 lb (130 kg)	280 lb (130 kg)
Total	17790 lb (8070 kg)	17790 lb (8070 kg)
NUMBER OF LUBRICATION POINTS:	97	
NUMBER OF HYDRAULIC CYLINDERS:	4 (wing lift) 2 (depth control) 2 (endmarker)	
OPTIONS INCLUDED ON TEST MACHINE:	- 39 ft (11.9 m) width - 7.2 in (183 mm) spacing - adjustable floating hoe type shank - endmarkers	
OTHER AVAILABLE OPTIONS:	- 27, 33, 45 and 57 ft (8.2, 10.1, 13.7 and 17.4 m) widths - 9 and 12 in (229 and 305 mm) shank spacing - 350 lb (1557 N) cultivator trip with standard field cultivator mounting (47°) is available with all spacings. - safety tow chain - lighting package - 3.5 in (89 mm) wide packers	

APPENDIX II

The following rating scale is used:
Excellent
Very Good
Good
Fair
Poor
Unsatisfactory

APPENDIX III



SUMMARY CHART

Flexi-coil 5000 AIR DRILL

RETAIL PRICE:	\$42,402 (May 1991, f.o.b. Lethbridge) for 39 foot 5000 Flexi-coil drill complete with 7.2" spacing, floating hoe opener and set-up \$3,069 for dual endmarkers complete with cycling valve, hydraulic lines and set-up.
QUALITY OF WORK:	
Penetration	very good; openers penetrated hard soils
Seed and Fertilizer Placement	very good; depended on travel speed and fan speed
Soil Finishing	very good; left majority of straw on surface in primary conditions
Trash Clearance	very good; plugged only in heavy wet straw conditions
Marking System	fair; mark usually not visible in untilled fields
EASE OF OPERATION AND ADJUSTMENT:	
Maintenance	good; 71 grease fittings required weekly servicing
Transporting	very good; 5 minutes to place in transport position
Marking System	good; operated from tractor with remote hydraulics
Depth Adjustment	very good; initial levelling was time consuming
POWER REQUIREMENTS:	varied from 193 PTO hp (144 PTO kW) to 254 PTO hp (190 PTO kW)
OPERATOR SAFETY:	safe; safety tow chain not supplied
OPERATOR'S MANUAL:	very good; clearly written
MECHANICAL HISTORY:	hoe points were worn out after 33 ac (13 ha) per point



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