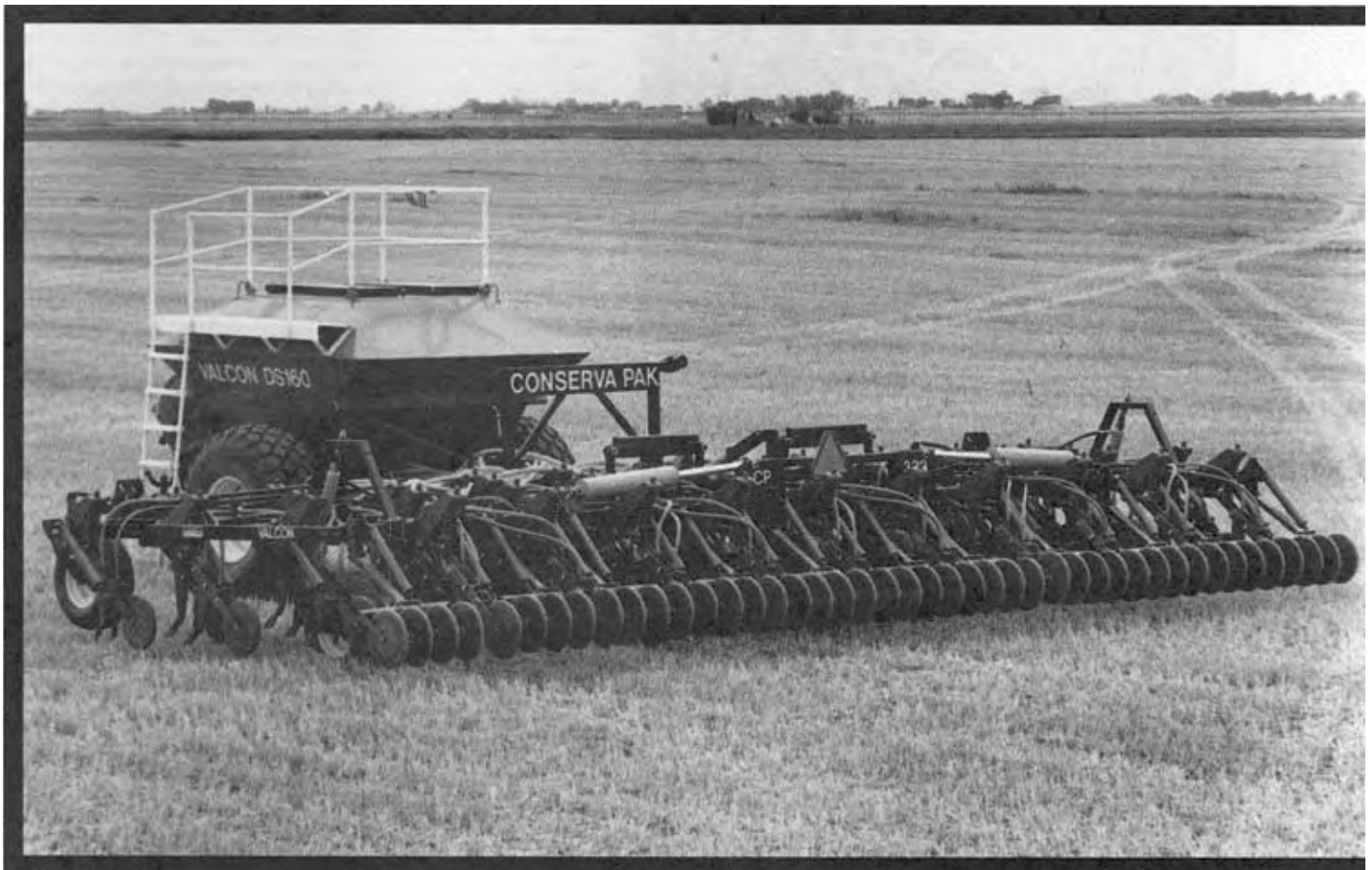


Evaluation Report

694



Conserva Pak CP Series Seeder

A Co-operative Program Between



CONSERVA PAK CP SERIES SEEDER

MANUFACTURER & DISTRIBUTOR:

Valcon Equipment
Box 417
Indian Head, Saskatchewan
S0G 2K0
Phone: (306) 695-2460

RETAIL PRICE:

\$ 57,500.00 [April, 1993, f.o.b. Humboldt, Saskatchewan], for 33 ft (10 m) width on a 9 in (229 mm) row spacing.

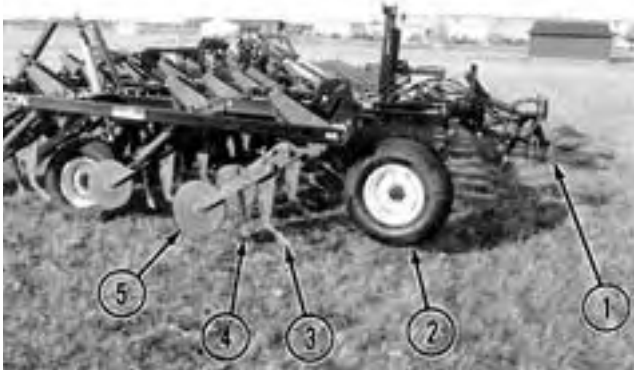


FIGURE 1. Conserva Pak CP Series Seeder: 1) Hitch, 2) Castor Wheels, 3) Fertilizer Opener, 4) Seed Openers, 5) Press Wheels.

SUMMARY AND CONCLUSIONS

Agronomic Performance: Seedling response was rapid and even in all direct seeding soil conditions. Fertilizer response was positive.

Quality of Work: Penetration was excellent for the fertilizer openers and good for the seed openers. The fertilizer openers penetrated well in all conditions. The seed openers also penetrated well provided that the fertilizer openers were at least 3.5 in (88 mm) deep. Seed and fertilizer placement was very good. Seed and fertilizer separation was maintained. Variations in seed depth were minimal when seeding in unworked stubble.

Soil finishing was very good. The majority of straw was left on the surface while direct seeding into standing stubble. Reduced ground speeds reduced trash burial, while placing fertilizer deeper increased trash burial.

Trash clearance was good. The four rows of openers allowed good trash flow in fairly evenly spread, heavy and dry straw. Seeding at an angle to the stubble rows in damp heavy straw improved trash clearance. Long unanchored damp straw tended to wrap on the fertilizer shanks.

Operation in stony conditions was fair. Many fertilizer points and one shank broke during the test. Maximum lift height of the fertilizer opener was 9 in (229 mm).

Ease of Operation and Adjustment: Ease of performing routine maintenance was good. Most grease fittings were accessible without much difficulty. Daily servicing took 10 minutes, while weekly servicing took 30 minutes.

Ease of transporting was very good. The machine was placed in transport in less than ten minutes. Installing the depth control hydraulic cylinder locks were inconvenient as it required climbing on the seeder frame. The wheel tread in transport was narrow so care was required when transporting on steep side slopes.

Ease of maneuvering in field position was good. When used with the Valcon DS 160 tow between seed cart, extremely sharp turns had to be avoided to prevent the seed cart tires from hitting the frame of the seeder. The view of the centre frame, where plugging usually occurred, was blocked by the tow between cart.

Ease of setting the seed and fertilizer depth was fair. The seed depth could be independently adjusted from the fertilizer depth. Adjustment for packing force and lateral spacing between the seed and fertilizer were also provided. These adjustments were very time consuming, although only limited readjustment was necessary after initial setting.

Power Requirements: The overall tractor size needed to pull the 33 ft (10 m) wide Conserva Pak seeder at normal fertilizer and seed depths at 5 mph (8 km/h) ranged from 130 to 162 hp (97 to 121 kW). Additional power was required for the seed tank.

Operator Safety: The Conserva Pak was safe to operate when the Precautions in the operator's manual and normal safety practices were observed. The seeder should be parked on a level area before placing the unit into or out of transport position.

Operator's Manual: The operator's manual was very good. The manual was clearly written with supportive pictures and illustrations. **Mechanical History:** Some shank assembly frame welds cracked and many fertilizer points broke.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Reshaping the fertilizer opener shank to prevent straw from wrapping.
2. Modifications to the fertilizer openers to reduce breakage in stony conditions.
3. Compliance with the Tire and Rim Association tire pressure guidelines.
4. Modifications to prevent the material delivery hoses from coming off the opener connections.

Senior Engineer: J.D. Wassermann

Project Manager: G.E. Hultgreen

Project Technologist: A.R. Boyden

THE MANUFACTURER STATES THAT:

1. We will consider reshaping the fertilizer opener shank to reduce straw wrapping.
2. We have informed our supplier of the fertilizer opener breakage and they have implemented modifications.
3. Centre frame tire pressure recommendation is 60 psi (420 kPa) and the rims currently used are rated to 85 psi (590 kPa) by our supplier.
4. We will investigate modifications to prevent material delivery hoses from coming off the opener connections.

Additional Comments:

1. We have relocated the stub for the left opener to improve straw and residue clearance.

GENERAL DESCRIPTION

The Conserva Pak seeder is a trailing three section side banding direct seeding hoe drill. The seed and fertilizer is placed in two rows at separate depths by the separate openers. The drill can be operated with any split air delivery system. Six different widths from 27 to 39 ft (8.2 to 11.9 m), with opener spacings of 9 or 12 in (229 or 305 mm) are available.

The fertilizer depth is set by depth control cylinders that vary frame height of the seeder and thus, fertilizer tip depth. There are four depth control wheels under the centre frame and one wheel for each wing. A casting gauge wheel at the front of each wing and an adjustable hitch provide fore-and-aft levelling of the frame.

The opener mechanism consists of a fertilizer shank with a knock-on point, a seed furrow opener, and a press wheel with an adjustable cushion spring system. The opener system is protected by a compression spring trip mechanism mounted on the seeder's frame. The depth of the seed openers was set by pin relocation on an adjustable yoke. This was located on the press wheel frame to achieve individual seed row depth control. The spacing between the seed and fertilizer rows can also be adjusted. The press wheels across the rear of the machine provide final reshaping of the surface furrows.

The wing frames are folded vertically by two hydraulic cylinders and over-centre for transport.

The test machine was 33 ft (10 m) wide with 44 openers spaced 9 in (229 mm) apart. The Conserva Pak was used with the Valcon DS 160 double shoot air delivery system during the test. FIGURE 1 shows the location of major components while FIGURE 2 shows

the components of the openers. Detailed specifications are given in APPENDIX I.

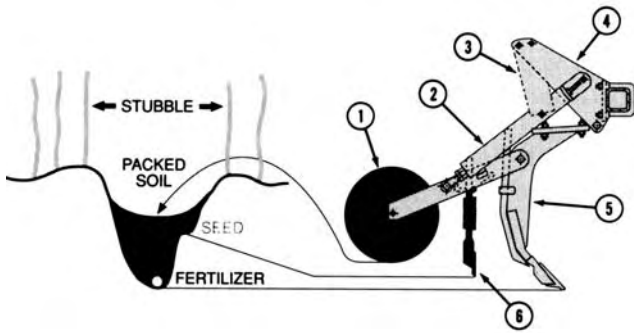


FIGURE 2. Opener Assembly: 1) Press Wheel, 2) Press Wheel Cushion Spring, 3) Compression Spring, 4) Frame Mount, 5) Fertilizer Opener Shank, 6) Seed Opener.

SCOPE OF TEST

The Conserva Pak CP Series Seeder was operated in the field conditions shown in TABLE 1 for 168 hours while seeding 1,827 ac (740 ha). The Conserva Pak was operated for the first 933 ac (378 ha) by PAMI in spring seeding conditions and for the remaining 894 ac (362 ha) by AFMRC in fall seeding conditions. The unit was evaluated for agronomic performance, quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual.

TABLE 1. Operation Conditions

Material	Soil Type and Condition	Stone Conditions	Field Area		Hours
			ac	ha	
Spring Wheat	Loam, Primary	Very Stony	110	45	16
		Stone Free	85	34	7
Spring Wheat	Sandy Loam, Primary	Occasional Stones	280	113	27
		Occasional Stones	105	43	10
Spring Wheat	Clay, Primary	Occasional Stones	100	40	11
Barley	Sandy Clay, Primary	Occasional Stones	107	44	11
Canola	Loam, Primary	Moderately Stony	76	31	9
Flax/Alfalfa	Silty Clay, Primary	Stone Free	70	28	8
Winter Wheat	Loam, Primary	Stone Free	341	138	28
Winter Wheat	Silty Loam, Primary	Stone Free	120	49	10
Winter Wheat	Sandy Loam, Primary	Occasional Stones	159	64	12
		Occasional Stones	161	65	11
Winter Wheat	Silty Loam, Secondary	Moderately Stony	83	34	6
Winter Wheat	Silty Loam, Secondary	Stone Free	30	12	2
Total			1827	740	168

The machine evaluated by PAMI and AFMRC was configured as described in the General Description, FIGURE 1, and the Specifications sections of this report. The manufacturer may have built different configurations of this machine before and after the tests. Therefore, when using this report, be sure to first check that the machine you are considering is the same as the one shown here. If differences are found, assistance can be obtained from PAMI, AFMRC or the manufacturer to determine how the machine will perform compared to the one tested.

RESULTS AND DISCUSSION

AGRONOMIC PERFORMANCE

Agronomic performance was very good.

A split air system was used to side band fertilizer in relation to the seed with the fertilizer placed at a depth of 3.5 in (88 mm). Complete separation of seed and fertilizer occurred under all conditions. Some variation in fertilizer placement depth occurred in rolling land due to the rigid hitch. However, any change in depth was within the range for optimum crop response.

Seed placement was 0.75 to 1 in (2.0 to 2.5 cm) to the side of the fertilizer band and at a depth set by the adjustment of the press wheels. Seed depth was uniform even under undulating soil conditions, due to the ground following action of the shank press wheels. Seed was placed into a firm moist seedbed with the majority of seeds placed within 0.4 in (10 mm) of the average seeding depth. A minimum fertilizer banding depth of 3.5 in (88 mm) was required to provide optimum conditions for accurate seed placement. A banding depth of less than 3.5 in (88 mm) reduced uniformity of seed placement with some seed left on the soil surface in the runs

behind the cultivator wheels.

The press wheels were adjustable in packing force and provided localized packing over the seed rows. The additional press wheels on the rear of the machine assisted in reforming the furrow from the front openers after soil was thrown into the front furrows by the back row of openers.

Emergence of wheat, barley, canola, flax and alfalfa was rapid and even in all conditions and soil types tested. This resulted in good weed competition. Most cereal crops did not require post-emergent herbicide application due to a combination of good weed competition and limited soil disturbance between the rows. In the canola crop, wild oat and volunteer cereal competition in the low areas of the field required an application of post-emergent herbicide. However, only about half of the field required this selective treatment with the herbicide.

Research indicates that side banded fertilizer is a highly efficient method of fertilizer placement. Field observations of crops seeded and fertilized using the Conserva Pak system supported this. Crops were observed to be lush and dark green.

QUALITY OF WORK

Penetration: Penetration was excellent for the fertilizer openers and good for the seed openers.

The fertilizer shanks and openers were narrow. The shanks were rigid but well protected by the non-adjustable compression spring shank mechanisms. Shank force (FIGURE 3), machine weight and opener configuration were sufficient for penetration in all soils encountered during the test, including hard unworked stubble. The seed openers utilized the preworking action of the fertilizer openers to penetrate. The fertilizer openers had to be 3.5 in (88 mm) deep to permit proper seed opener penetration behind the seeder tires.

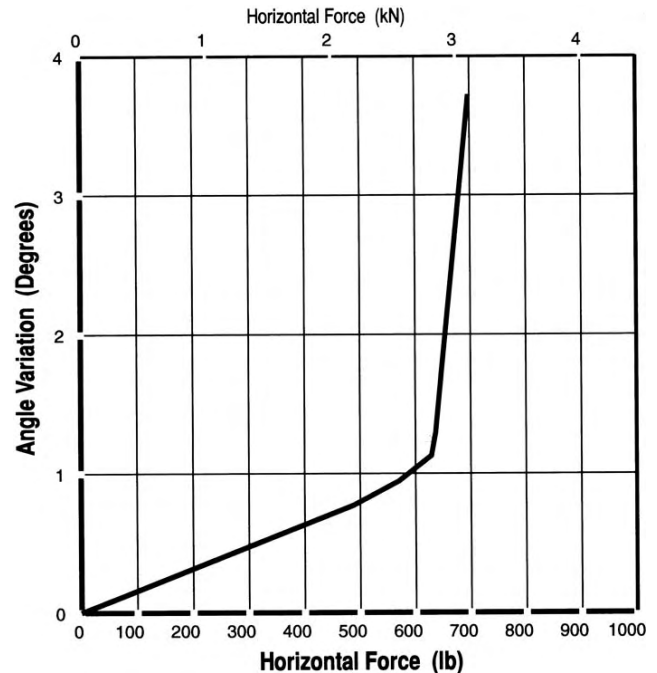


FIGURE 3. Fertilizer Shank Trip Force.

Seed and Fertilizer Placement: The seed and fertilizer placement was very good.

Seed was usually placed in a separate row about 0.75 to 1.0 in (19 to 25 mm) to the right and above the fertilizer row.

Seed depth in each row was individually controlled by the trailing press wheel, since the openers were mounted on the press wheel support arms. Variations in seed depth were minimal when seeding into unworked stubble. For example, at an average seed depth of 1.5 in (43 mm) most of the seeds were placed within 0.4 in (10 mm) of the average depth. The seed and fertilizer rows were usually very distinct and about 0.75 in (19 mm) wide.

Fertilizer depth was normally 3.5 in (88 mm). Variation in depth occurred in rolling land as the hitch was rigid, however, fertilizer depth, which is not as critical as seed depth, remained within an acceptable range.

Ground speeds were usually kept below 5 mph (8 km/h) to improve soil coverage of the seed. This also reduced the amount of soil that was thrown ahead of the shanks and onto adjacent rows. The Conserva Pak was stable with only slight skewing occurring on steep hill sides. Skewing did not greatly affect the press wheels position over the seed rows, since the press wheels were attached to the openers. The only effect from skewing was slight variation in the row spacing.

Soil Finishing: Soil finishing was very good.

FIGURE 4 shows the soil surface after direct seeding into a wheat stubble field.

The majority of the straw was left on the surface, with much remaining upright. In shod wheat stubble at 5 mph (8 km/h), only 13% of the trash was buried. In high canola stubble at the same speed, 20% of the trash was buried. Reducing ground speed to 3.5 mph (5.8 km/h) usually reduced trash burial even further. Placing the fertilizer deeper resulted in increased trash burial.



FIGURE 4. Typical Soil Surface After Direct Seeding into Wheat Stubble.

The packing force was adjustable and adequate for the soil conditions encountered during the test. The combination of shank mounted and trailing press wheels at the rear of the machine provided uniform furrows in all seed rows. Furrow depth left by the press wheels was usually 2 in (50 mm) depending on soil conditions. In dry conditions, this allowed the seed to be placed deeper into the soil for access to soil moisture without having an excessive soil covering. In wet conditions, mud stuck to the furrow opener causing wider furrows to be formed (FIGURE 5). Mud also built up on press wheels.



FIGURE 5. Furrow Openers in Wet Conditions.

Trash Clearance: Trash clearance was good.

The machine had four rows of openers with equal lateral spacing of the shanks in each row. This allowed trash flow in fairly evenly spread, heavy and dry straw. Some plugging occurred between the wheels of the centre frame in uneven or damp heavy straw conditions. Plugging also occurred at the outer left end of the seeder as the front shanks were more closely spaced (FIGURE 7). Seeding at an angle to the stubble rows improved trash clearance, even when wads or small rows of straw were encountered.

As with most direct seeders, stubble length should not exceed row spacing. Long damp straw tended to wrap on the shank above the fertilizer opener. A small notch in the shank prevented smooth movement of the trash up the shank for clearing. It is recommended that the manufacturer consider reshaping the fertilizer shank to prevent straw from wrapping.

Stony Conditions: Operation in stony conditions was fair.

During the first 933 ac (378 ha) of field testing, 37 fertilizer points and one shank broke. A different batch of openers was tried, but breakage still occurred. In the last 894 ac (362 ha) where the stone conditions were not as severe, no further breakage occurred. However, openers must be able to withstand various stone conditions. It is recommended that the manufacturer consider modifications to the openers to reduce breakage in stony conditions.

Maximum lift height of the fertilizer opener was 9 in (229 mm). The fertilizer hoses of the air delivery system could be pinched against the cushion springs of the shank if the shank was forced to lift to the maximum height. However, no damage of this nature occurred during the test.

EASE OF OPERATION AND ADJUSTMENT

Maintenance: Ease of performing routine maintenance was good. Most grease fittings were accessible without much difficulty. The 11 grease fittings on the rear press wheels assembly required grease daily.

The remaining 118 grease fittings required grease weekly or every 50 hours of operation. It took one person about 10 minutes to do daily servicing and about 30 minutes to do the 50 hour servicing. Repacking the 8 wheel bearings was required annually.

The fertilizer points were of a knock-on type. It took one person only about one hour to remove and replace the 44 fertilizer openers.

Transporting: Ease of transporting was very good.

Less than ten minutes was required to place the unit into transport position (FIGURE 6). Transport locks were provided for the wings in the upright position. Transport locks were also provided for the centre frame depth control hydraulic cylinders. However, installing these locks was inconvenient as it required climbing on the seeder frame.



FIGURE 6. Transport Position.

Transport width was 13.1 ft (4 m) and transport height was 16.2 ft (4.9 m). Caution was required when transporting the unit because of the high transport height. The transport width is only slightly greater than the width of a typical tractor with dual wheels. This made transporting on narrow roads and approachways more convenient. The wheel tread of 9.9 ft (3.0 m) was narrow and care was required when transporting on steep side slopes, such as road sides or at field approaches.

Maneuverability: The ease of maneuvering in field position was good.

When used with the Valcon DS 160 tow between seed cart, extremely sharp turns had to be avoided to prevent the seed cart tires from hitting the frame of the seeder. A third pass on the headlands at the ends of the field were required to seed the entire area missed during turns.

The gauged distance to drive from the previous pass was different for each side of the machine as there was an extra shank on the left side (FIGURE 7). Gradual turns while seeding around obstacles was inconvenient when the Valcon DS 160 tow between

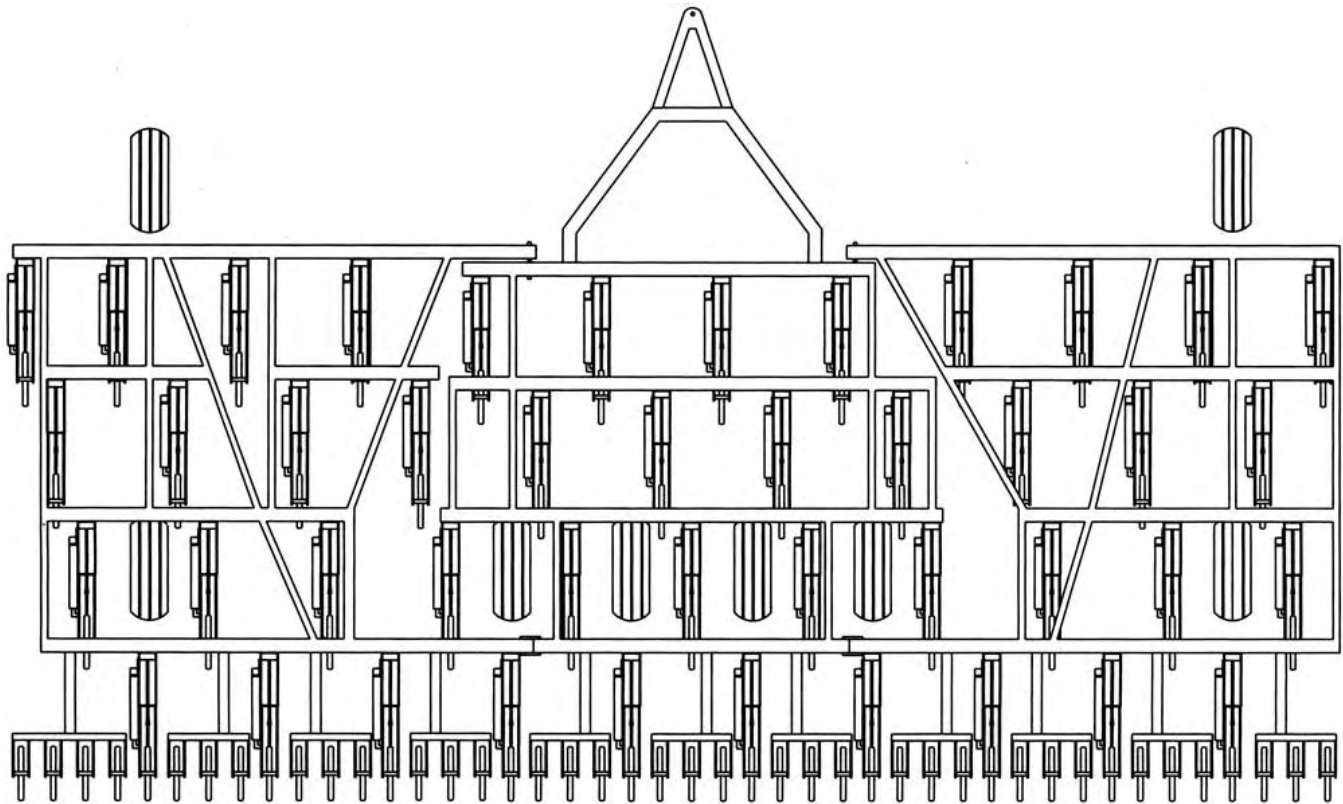


FIGURE 7. Opener Pattern.

seed cart was used. The view of the outer end of the seeder was blocked by the seed cart. The view of the centre frame, where plugging usually occurred was also blocked by the seed cart.

The wing frames of the Conserva Pak flexed noticeably while turning at headlands or moving across the field with the seeder out of the ground. Slower ground speeds reduced the wing flexing.

Depth Adjustment: Ease of setting the seed and fertilizer depths was fair.

The seed depth could be independently adjusted from the fertilizer depth. Individual adjustments were also provided for press wheel height and force, and for lateral spacing between the seed and fertilizer.

Fertilizer depth of the entire machine was set by an adjustable collar on the two centre frame depth control cylinders. Fore-and-aft frame levelling was required for each new depth setting by adjusting the ratchet jacks at the gauge wheels and hitch. Once the fertilizer depth was set to 3.5 in (88 mm), no further adjustment was required in the test.

Seed depth was adjusted at each tube holder in 0.25 in (6 mm) increments by removing one pin. The press wheel height and pressure were adjusted using two wrenches on the nuts at the ends of the pressure springs.

Lateral seed opener position was adjusted by removing a bolt on each shank and relocating the opener to a new hole. The normal position for the seed opener was 0.75 in (19 mm) to the right side of the fertilizer opener. The lateral spacing between the seed and fertilizer was seldom changed through the test.

A specific order on all adjustments had to occur as indicated in the operator's manual to prevent unnecessary readjustment. The individual shank adjustments were more time consuming than on machines that have a single adjustment but more convenient than some other machines with individual seed depth control. For example, seed depth adjustment took 20 minutes. Limited readjustment of these settings was necessary after initial setting.

POWER REQUIREMENTS

Draft Characteristics: Draft (drawbar pull) requirements depended on depth, ground speed and soil moisture and texture. At the maximum speed, 5 mph (8 km/h), and at normal fertilizer and seed depths in a hard loam soil, draft ranged from 6,510 to 8,150 lb (29.0 to 36.3 kN) for the 33 ft (10 m) test machine.

Tractor Size: The overall tractor size needed to pull the 33 ft (10 m) wide Conserva Pak at normal fertilizer and seed depths at 5 mph (8 km/h) varied from 130 to 162 hp (97 to 121 kW). Additional tractor size needed to pull the Valcon DS 160 seed cart with PTO fan drive, that was used during the test, when full of wheat at 5 mph (8 km/h) ranged from 46 to 58 hp (34 to 43 kW). These tractor sizes have to be adjusted to include tractive efficiency and represent a tractor operating at 80 percent of its maximum power take-off rating. The tractor sizes given will be suitable for most conditions, although more power may be required in rolling land or heavy pulling soil conditions.

OPERATOR SAFETY

The Conserva Pak was safe to operate when the precautions in the operator's manual and standard safety practices were observed. A slow moving vehicle sign was provided at the rear of the machine.

Transport locks were provided for the wings in upright position, and the depth control cylinders of the centre frame. The seeder should be parked on a level area before placing the unit into or out of transport position.

The manufacturer's tire inflation pressure of 60 psi (410 kPa) is greater than the maximum inflation pressure of 52 psi (360 kPa) recommended for the rims by the Tire and Rim Association. It is recommended that the manufacturer consider compliance with the Tire and Rim Association tire pressure guidelines.

OPERATOR'S MANUAL

The Operator's Manual was very good.

Useful information on machine principles, operation, maintenance, trouble shooting, adjustments, and safety was contained in the manual. The manual was clearly written with supportive pictures and illustrations. A parts listing was not provided.

MECHANICAL HISTORY

The Conserva Pak was operated for 168 hours while seeding 1827 ac (740 ha). The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted. TABLE 2 outlines the mechanical problems that occurred during the functional testing.

TABLE 2. Mechanical History

Item	Operating Hours	Field Area ac	Field Area (ha)
-A shank was relocated to prevent plugging at		The beginning of the test	
-A shank broke and was replaced at	104	863	(349)
-Thirty-seven fertilizer Edge-on openers broke. These were replaced		Throughout the PAMI test	
-Six shank assembly frames had cracked and were welded at	112	933	(378)
-A seed boot broke and was welded at	146	1353	(548)
-The ratchet jack on the hitch A-frame came apart and was reassembled at	156	1489	(603)
-A roll pin on right wing pivot sheared and was replaced at	162	1577	(638)
-Several hoses came off their connections at the shanks and were reinstalled		Throughout the test	

Shank Assembly Frame Cracking: The welds on six assemblies cracked due to inadequate penetration (FIGURE 8). Once rewelded properly, no further cracks occurred.



FIGURE 8. Shank Assembly Weld Cracks.

Fertilizer Opener Breakage: Most breakage occurred in moderately to very stony conditions during the PAMI test. A different batch of openers was tried, but breakage still occurred. In the AFMRC tests, where stone conditions were not as severe, no breakage occurred. However, openers must be able to withstand various stone conditions. A recommendation has already been made.

Hoses Coming Off: Hoses came off the connections to the shanks in stony conditions when the shanks tripped over rocks. It is recommended that the manufacturer consider modifications to prevent material delivery hoses from coming off the opener connections.

Fertilizer Point Wear: FIGURE 9 shows the average wear of the fertilizer point at the end of the test. These points were nearly worn out after 1827 ac (740 ha) or 42 ac (17 ha) per point. Cost of the replacement point was \$18.00.



FIGURE 9. Hoe Point Wear.

**APPENDIX I
SPECIFICATIONS**

MAKE:	Conserva Pak CP Series Seeder	
MCOEL:	339	
SERIAL NUMBER:	92-8	
MANUFACTURER:	Valcon Equipment P.O. Box 417 Indian Head, Saskatchewan S0G 2K0	
OVERALL DIMENSIONS:	<u>Field Position</u>	<u>Transport Position</u>
-- height	6.8 ft (2.2 m)	16.2 ft (4.9 m)
-- length	20.7 ft (6.8 m)	20.7 ft (6.8 m)
-- width	33.2 ft (10.9 m)	13.1 ft (4.3 m)
-- effective seeding width	33.0 ft (10.0 m)	
-- transport ground clearance		
-- packers		6.5 in (165 mm)
-- fertilizer tips		9.0 in (228 mm)
-- wheel tread	27.9 ft (8.5 m)	9.9 ft (3.0 m)
SHANKS:		
-- number	44	
-- row spacing	9 in (290 mm)	
-- vertical clearance	31 in (790 mm)	
-- number of rows	4	
-- distance between rows	36, 42, 39 in (91, 107, 99 mm)	
PRESS WHEELS:		
-- type	molded polyethylene	
-- diameter	16 in (406 mm)	
-- width	1.5 in (38 mm)	
-- number	44, one mounted to each shank 34, mounted in gangs at the rear	
HITCH:	ratchet jack system infinite levelling adjustment range	
DEPTH CONTROL:		
-- fertilizer	adjustable cellar on main frame cylinders	
-- seed	pin on each opener	
FRAME:		
-- number of sections	3	
-- frame member size	4 x 4 in, 2 x 3 in, 3 x 3 in (100 x 100 mm, 50 x 75 mm, 75 x 75 mm)	
SUPPORT WHEELS:		
-- centre frame	4 - 11 x 15LT, 12-ply rating	
-- wing frame	2 - 11 x 15LT, 8-ply rating	
CASTOR WHEELS:		
-- gauge	2, 11 x 15LT, 8-ply rating	
LEVELLING:		
-- gauge wheels	adjustable turnbuckles	
-- wing frames	adjustable rod on ram pivot	
-- centre frame	adjustable eyebolt between wheels	
WEIGHTS:	<u>Field Position</u>	<u>Transport Position</u>
-- left castor (wing)	3050 lb (1380 kg)	
-- right castor wing	3100 lb (1410 kg)	
-- left transport wheels	3650 lb (1660 kg)	6650 lb (3020 kg)
-- right transport wheels	3300 lb (1500 kg)	6250 lb (2840 kg)
-- hitch	1700 lb (770 kg)	1900 lb (860 kg)
Total	14,800 lb (6720 kg)	14,800 lb (6720 kg)
NUMBER OF LUBRICATION POINTS:	129 grease points	
HYDRAULIC CYLINDERS:		
-- centre frame	2, 3.5 x 12 in (89 x 305 mm)	
-- wing frame	2, 3.25 x 12 in (83 x 305 mm)	
-- hitch	1, 4.25 x 12 in (108 x 305 mm)	
-- transport	2, 6 x 30 in (150 x 706 mm)	
OPTIONS:		
-- seeding widths	27, 28, 33 and 39 ft (8.2, 8.5, 10 and 11.9 m)	
-- opener spacings	9 or 12 in (229 or 305 mm)	

**APPENDIX II
MACHINE RATINGS**

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Fair
Very Good	Poor
Good	Unsatisfactory

SUMMARY CHART

CONSERVA PAK CP SERIES SEEDER

RETAIL PRICE:	\$ 57,500.00 [April, 1993, f.o.b., Humboldt, Saskatchewan], for 33 ft (10 m) wide Conserva Pak on 9 in (229 mm) row spacing
AGRONOMIC PERFORMANCE:	Very Good; rapid seedling emergence and positive fertilizer response in all direct seeding soil conditions and crop types
QUALITY OF WORK:	
Penetration	Excellent; for the fertilizer opener, penetrated in all soil conditions Good; for the seed openers, penetrated if fertilizer opener at least 3.5 in (88 mm) deep
Seed and Fertilizer Placement	Very Good; maintained seed and fertilizer separation
Soil Finishing	Very Good; depended on speed and depth
Trash Clearance	Good; angle seeding improved residue flow
Stony Conditions	Fair; broke fertilizer points and one shank during first 933 ac (378 ha), but no further breakage in the last 894 ac (362 ha) of test
EASE OF OPERATION AND ADJUSTMENT:	
Maintenance	Good; 11 daily and 118 weekly lubrication points
Transporting	Very Good; 13.1 ft (4 m) wide in transport
Maneuverability	Good; sharp turns had to be avoided
Depth Adjustment	Fair; individual seed boot adjustment was necessary to change seed depth, limited readjustment necessary after initial setting
POWER REQUIREMENTS:	PTO horsepower requirements varied from 130 to 162 hp (97 to 121 kW) for the seeder without air delivery system
OPERATOR SAFETY:	generally safe, but caution required when securing depth stops in transport position
OPERATOR'S MANUAL:	Very Good; contained useful information
MECHANICAL HISTORY:	mounting brackets on six shank assemblies were rewelded after 933 ac (378 ha)



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