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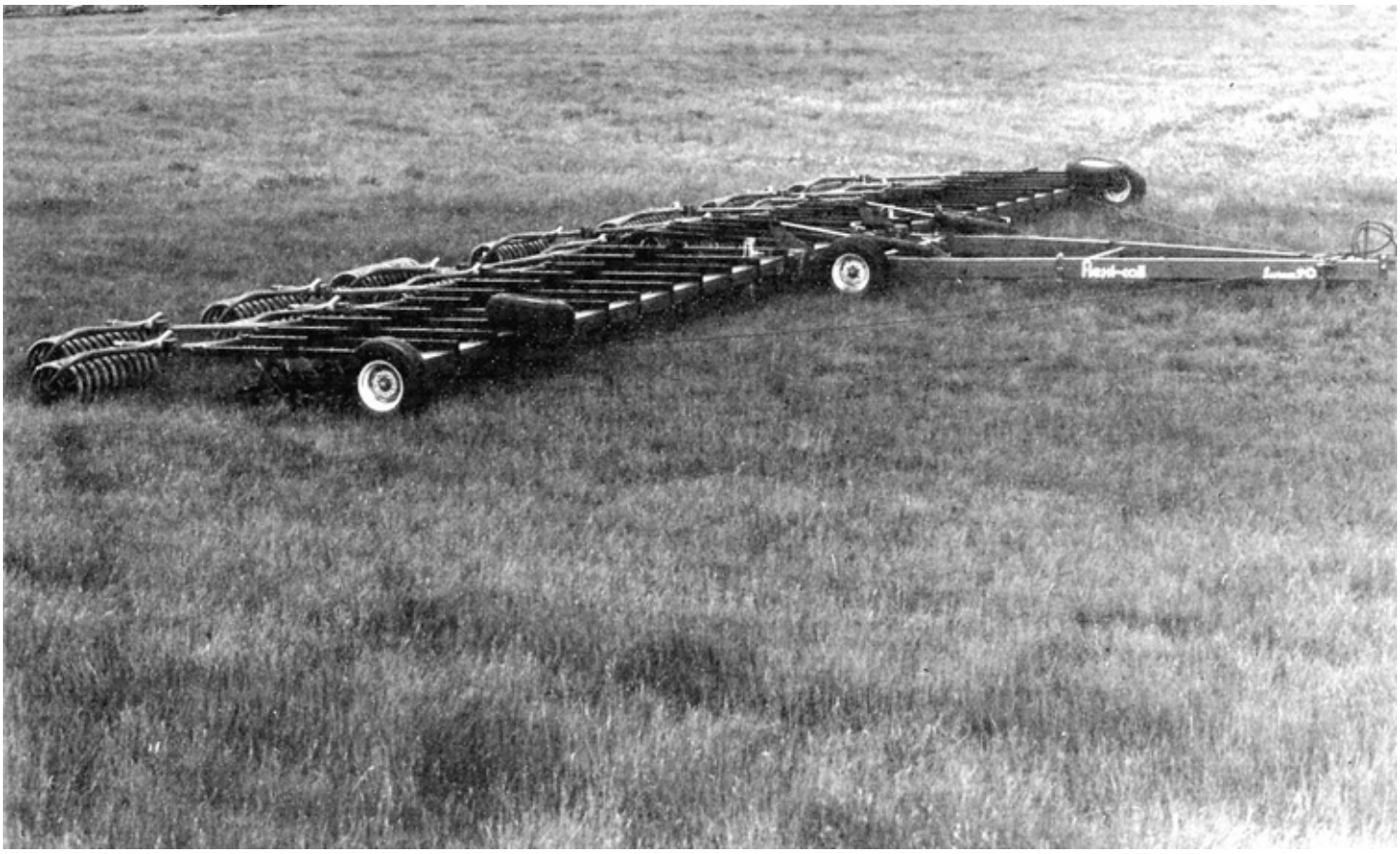

Flexi-coil System 90 (21.3 m) Harrow Packer Drawbar

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

FLEXI-COIL SYSTEM 90 HARROW PACKER DRAWBAR

MANUFACTURER AND DISTRIBUTOR:

Flexi-coil Ltd.
P.O. Box 1928
Saskatoon, Saskatchewan
S7K 3S5

RETAIL PRICE: $19 346.00 (July, 1982, f.o.b. Lethbridge, Alberta, 21.3 m width).

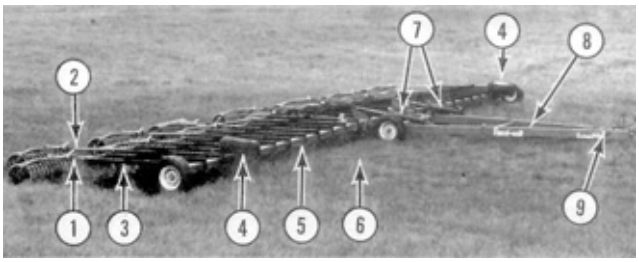

FIGURE 1. Flexi-coil System 90 Harrow Packer Drawbar: (1) Short Packer Draw, (2) Long Packer Draw, (3) Harrow Support Arm, (4) Transport Wheels, (5) Boom, (6) Wing Draw Cable, (7) Lift Cylinders, (8) Wing Cable Pivot Arm, (9) Cable Pivot Arm Latch.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Flexi-coil System 90 harrow packer drawbar was very good.

The tine harrows performed well under most conditions encountered when adjusted to spread trash and to level the soil surface. Plugging of the harrows occurred when operating in heavy trash conditions at steep harrow tine angles. The harrows levelled rough surfaces well, broke loose soil lumps, and trailed well on sharp turns.

The packers performed well in all field conditions and trailed well during sharp turn. The packing force was suitable for creating a firm seedbed.

The Flexi-coil System 90 was very stable and maneuvered well in field position. Turning maneuverability was reduced by packer interference at the boom hinge points when turning in transport position. The Flexi-coil was very convenient to put into field position but often required the operator to dismount and lift the wing cable pivot arm when placing the unit into transport position. Excessive load on the transport tires made travelling in transport position at high speeds unsafe. Hitching to the Flexi-coil System 90 was safe and convenient in both field and transport position if the jack and jack stands provided were used.

Adjustment of the harrow tine angle was convenient and could be performed without tools.

A tractor with a maximum power take-off rating of 110 kW (148 hp) was required to operate the 21.3 m (70 ft) unit.

Assembly, safety, lubrication and maintenance instructions, as well as a complete parts list, were supplied. No operating instructions were included.

A slow moving vehicle sign was not provided.

Some minor mechanical problems encountered included wing cable attaching brackets sliding along the boom and harrow tine interference with the wing tires.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to the wing cable pivot arm geometry to improve the ease of changing from field to transport position.
2. Modifications to prevent interference between the field position wing wheels and harrow tines.
3. Modifications to reduce tire overload in transport position.
4. Suppling a slow moving vehicle sign as standard equipment.
5. Supplying more complete operating instructions.

Senior Engineer: E. H. Wiens

Project Engineer: R. K. Allam

THE MANUFACTURER STATES THAT

The Flexi-coil System 92 Harrow Packer Drawbar introduced in 1982 provides a number of improvements and additional features over the System 90 Drawbar tested in this report.

With regard to recommendation number:

1. The System 92 Drawbar has improved geometry which provides positive fold arm lift when changing from field to transport position.
2. Clearance between the harrow and wing tire has been increased on the System 92 to prevent any interference.
3. The System 92 Harrow Packer Drawbar had dual walking beam axles on the hitch as standard equipment.
4. A slow moving vehicle sign will be provided as standard equipment on units manufactured in 1983.
5. Revised operating instructions are under consideration.

NOTE: This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX II.

GENERAL DISCRIPTION

The Flexi-coil System 90 is a 21.3 m (70 ft) wide harrow and packer drawbar for use in seed bed preparation and soil finishing after seeding.

The System 90 consists of one row of fourteen 1.5 m (5 ft) harrows, equipped with double tine teeth with a forward bend, and fourteen 1.5 m (5 ft) steel coil packers that produce a packing force of 1825 N/m (125 lb/ft) of width. The harrow sections are hung from the lift arms by chains while the packer draws are attached to the ends of the lift arm with swivel connectors. The packers are in two rows of seven each and are preceded by the single row of harrows. A U-joint is located in each packer draw to allow free movement of the packer sections. Dual hydraulic cylinders, mounted on the mainframe, raise the harrows and packers into transport position and release a latch mechanism on the wing cable pivot arm. Releasing the pivot arm allows the wings to fold rearward for transport position as the machine is driven forward.

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

SCOPE OF TEST

The Flexi-coil System 90 was operated in the field conditions shown in TABLE 1 for 110 hours while processing about 1835 ha (4532 ac). It was evaluated for quality of work, ease of operation and adjustment, power requirements and safety. The harrow packer drawbar was used predominently for seedbed finishing after seeding with air seeders.

TABLE 1. Operating Conditions

FIELD CONDITION	HOURS	FIELD AREA (ha)
Cultivated wheat stubble	50	834
Cultivated barley stubble		500
Cultivated rapeseed stubble		167
Summerfallow		334
TOTAL	110	1835

RESULTS AND DISCUSSION

QUALITY OF WORK

Soil Finishing: The five bar spring tine harrows with a forward bend were effective in smoothing surface ridges, spreading loose trash and breaking loose soil lumps. The steel coil packers further served to level the soil and break soil lumps. The harrows were effective in uprooting and exposing weeds loosened by a cultivator. Surface ridges formed by the packer coils ranged in depth from 30 mm (1.2 in) in soft soil conditions to 25 mm (1 in) in firmer soil.

FIGURE 2 shows a stubble field seeded with an air seeder as the first spring operation, both before and after soil finishing with the Flexi-coil System 90 harrow packer drawbar. FIGURE 3 shows a summerfallow field seeded with an air seeder as a second operation, both before and after soil finishing with the harrow packer drawbar.

Harrow and packer soil levelling effectiveness was increased when the System 90 was operated at an angle to the direction of seeding. Double packing cultivated fields in different directions from each other resulted in a very smooth field surface. This was not considered necessary in all cases.

FIGURE 2. Field Seeded with an Air Seeder in Primary Tillage (Upper: Before Packing, Lower: After Packing.)

Harrows: Although the optional double tine teeth with a forward bend were more aggressive in soil finishing than straight tine teeth, they tended to collect more loose trash. The harrow tine angle was fully adjustable and the tines could be adjusted to clear the loose trash under most dry conditions. When fully plugged, the harrows could easily be cleared by raising the harrows with the transport cylinders. For applications where heavy trash cover is frequently encountered, harrows with straight teeth may provide better trash clearance. The harrow sections were properly spaced and covered well, even on sharp turns.

Packing: Packing force of the 44.5 mm (1.75 in) square coil packers was approximately 1825 N/m (125 lb/ft). This packing force was adequate to form a firm seedbed for good crop emergence.

FIGURE 3. Field Seeded with an Air Seeder in Secondary Tillage Conditions (Left: Before Packing, Right: After Packing).

Coverage by the coil packers was even and correct packer alignment was maintained when turning.

In moist conditions, care had to be taken to avoid overpacking of the seedbed.

Skewing and Stability: The Flexi-coil System 90 was very stable. Sideways skewing was not a serious problem in normal field conditions. Normal allowance had to be made to maintain implement placement for consecutive passes in hilly conditions.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Flexi-coil System 90 was placed into transport position (FIGURE 4), using the dual hydraulic cylinders provided, in less than five minutes. The hydraulic cylinders were connected in parallel and were operated using a tractor remote outlet. The hydraulic cylinders rotated the boom 90 degrees, lifting the harrow support arms which raised both the harrows and the packers off the ground. As the boom rotated, the transport wheels were lowered to the ground and the cable latch was disengaged. Driving the implement ahead slowly, caused the wing cable pivot arm to swing upwards, allowing the wings to fold rearward for transport position. A safety transport lock-up chain was provided for the lift cylinders.

When changing from field to transport position, the wing cable pivot arm frequently required manual lifting in order to over-center it (FIGURE 5). This required the operator to dismount from the tractor and place a block under the pivot arm to hold it up while driving ahead. Failure to lift the pivot arm before driving ahead could result in wing transport wheel axle damage. It is recommended that the manufacturer consider modifications to the wing cable pivot arm geometry to allow field to transport position changes without manually lifting the wing cable pivot arm.

Overall transport width was 3.9 m (12.8 ft) while transport height was 2.9 m (9.5 ft). The Flexi-coil 21.3 m (70 ft) System 90 towed well at normal transport speeds. When towing with a light truck, sufficient ballast should be added to compensate for negative hitch weight.

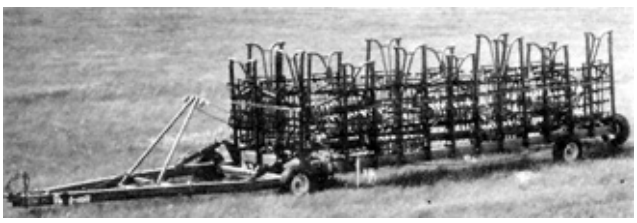

FIGURE 4. Flexi-coil System 90 in Transport Position.

Field Position: Changing from transport to field position with the Flexi-coil System 90 was relatively easy. Backing the unit while maintaining proper mainframe section alignment, allowed the wings to fold out into field position evenly. The wing

cable pivot arm swung down automatically when the wings were completely folded out. The cable pivot arm latch locked as the hydraulic cylinders lowered the harrows and packers to the ground. Driving ahead slowly while lowering the unit was necessary to allow the packer sections to trail out behind the harrow sections. Failure to pull ahead while lowering the unit would cause packer sections to fold under the harrows.

FIGURE 5. Operator Lifting the Wing Cable Pivot Arm for Transport Position.

Hitching: The Flexi-coil System 90 had a negative hitch weight of 1246 N (280 lb) in transport position and 1424 N (320 lb) in field position. As supplied, the unit could not be hitched to a tractor without the use of a jack on the rear of the mainframe to lower the hitch. The manufacturer supplied a changeover kit which included dual jacks. These jacks were positioned at the rear of the mainframe booms and allowed the unit to be conveniently hitched and unhitched in both field and transport position.

Hitching convenience was increased by the fact that the hitch link remained horizontal when unhitched from the tractor. Hitching also required the hook-up of two hydraulic lines with quick couplers to the tractor remote outlets.

Maneuverability: Maneuverability of the Flexi-coil System 90 was good in both transport and field position. In field position, corners could be made with the inside wheel travelling in a circle of about 2.2 m (7.2 ft) in diameter. This resulted in a turning radius of about 22.4 m (73.5 ft). In transport position, a turning radius of 11.6 m (38 ft) permitted easy negotiation of most 90 degree corners enountered. Sharper turns in transport position were limited by packer interference at the boom hinge positions (FIGURE 6).

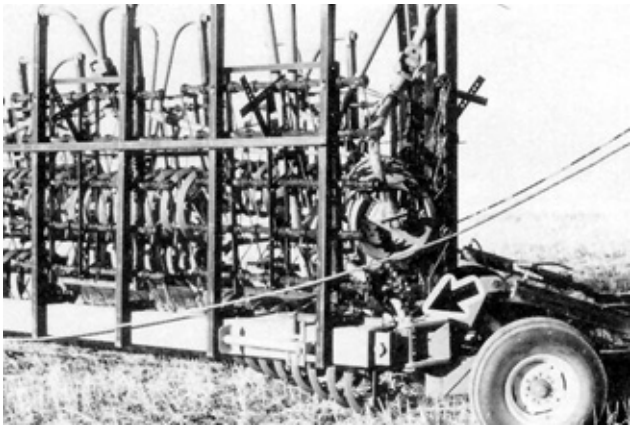

FIGURE 6. Packer Interference at the Boom Hinge Position when making Sharp Turns in Transport Position.

Harrow Tine Angle Adjustment: The harrow tine angle was easily adjusted in one of six positions without the use of tools. The six positions provided adequate adjustment for all conditions encountered.

Servicing: Operating instructions recommended lubrication of the 28 grease fittings on the packer axle bearings every 100 hours and the eight grease fittings on the boom every 20 hours. Wheel bearings required repacking annually.

POWER REQUIREMENTS

Draft: Average draft for the 21.3 m (70 ft) Flexi-coil System 90 harrow packer drawbar ranged from 17.2 kN (3865 lb) to 27.8 kN (6247 lb) at speeds ranging from 5 to 10 km/h (3 to 6 mph) in a preworked summerfallow with light trash cover.

Maximum draft occurred at the steepest harrow angle setting and minimun draft occurred at the lowest harrow angle setting. This was due to a greater amount of trash being dragged by the harrows as well as increased tine aggressiveness at the steeper harrow angle settings.

Tractor Size: Field power measurements indicated that a tractor with a maximum power take-off rating of 110 kW (148 hp) was required to operate the 21.3 m (70 ft) harrow packer drawbar on level ground at normal field speeds for an intermediate harrow angle setting. This tractor size has been adjusted to include tractive efficiency and the tractor operating at 80% of maximum power on a level field.

OPERATOR SAFETY

Caution was required when unhooking the Flexi-coil System 90 from the tractor to ensure the rear hitch jacks were in position to hold the hitch down as the tractor pulled away. Failure to adjust the jacks to the proper height could result in the hitch lifting up, causing possible operator injury.

Caution was also required when walking around the wing cables with the unit in field position. The cables were suspended 0.5 m (1.6 ft) above the ground and were difficult to see in poor light conditions.

A mechanical transport lock-up chain for the lift cylinders was supplied.

The Flexi-coil was 3.9 m (12.8 ft) wide in transport position. This necessitated caution when towing on public roads, over bridges and through gates.

Transport wheel tire loads exceed the Tire and Rim Association maximum load rating for 11 L-15, 8-ply tires by 47%. It is recommended that the manufacturer consider modifications to reduce wheel overload in transport.

No slow moving vehicle sign was provided. It is recommended that a slow moving vehicle sign be provided as standard equipment.

OPERATOR'S MANUAL

Assembly, safety, lubrication and maintenance instructions, as well as a complete parts list, were supplied. No operating instructions were included. It is recommended that complete operating instructions be supplied.

DURABILITY RESULTS

TABLE 2 outlines the mechanical history of the Flexi-coil System 90 during 110 hours of field operation. The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted.

TABLE 2. Mechanical History

ITEM	OPERATING EQUIVALENT HOURS	OPERATING EQUIVALENT FIELD AREA (ha)
The wing cable attaching brackets slid along the boom at	6, 23	100, 385
Two harrow chains were rebolted to the harrow sections at	6, 67	100, 1120
The right and left outermost front harrow tines were removed to avoid interference with the wing tire at	37	615
A harrow tine was bent by a packer during a tight turn at	45	750
Stops were welded to prevent the wing cable brackets from sliding along the booms at	67	1120
Manufacturer's modifications were performed at	67	1120
Two packer grease fittings were damaged by rocks and replaced at	67	1120

A packer draw arm was bent while transporting through a ditch and was replaced at	89	1485
A manufacturer's hitch jack kit was installed at	89	1485

DISCUSSION OF MECHANICAL PROBLEMS

Wing Cable Brackets: The wing cable attaching brackets did not fit snugly around the boom and even with the clamping bolts very tight, the brackets would slide along the boom. Stops were welded on the boom to prevent the brackets from sliding and no more problems were encountered.

Harrow Tine Interference: The outermost front row set of tines were removed due to interference with the wing tires when changing from transport to field position (FIGURE 7). It is recommended that the manufacturer consider modifications to prevent harrow tine interference with the wing wheels.

Manufacturer's Modifications: Manufacturer's modifications included the installation of slider bars along the inside of the booms to allow the packers to slide away from the boom pivot point in transport position while turning corners. A hitch jack kit was also supplied for placement at the rear of the mainframe to hold the hitch down for convenient hitching and unhitching.

FIGURE 7. Harrow Tine Removed to Prevent Tire Interference with Wing Wheel.

APPENDIX I

SPECIFICATIONS

MAKE:	Flexi-coil Harrow Packer Drawbar	
SERIAL NUMBER:	783 x 1	
MODEL:	System 90 (21.3 m width)	
MANUFACTURER:	Flexi-coil Ltd. P.O Box 1928 Saskatoon, Saskatchewan S7K 3S5	
DIMENSIONS:	**FIELD POSITION**	**TRANSPORT POSITION**
width	21,700 mm	3890 mm
length	11,285 mm	15,640 mm
height	980 mm	2920 mm
minimum ground clearance		175 mm
wheel tread	21,110 mm	3105 mm
PACKERS:		
type	coiled steel, 44.5 mm square	
number	14	
width	1525 mm	
coil diameter	495 mm	
coil pitch	140 mm	
rows	2	
weight	284 kg	
HARROWS:		
type	double tine tooth with forward bend	
number	14	
rows of tines	5	
row spacing	280 mm	
tine spacing	185 mm	
tine length	356 mm	
tine diameter	9.5 mm	
HITCH:		
vertical adjustment range	160 mm, 4 positions	
FRAME:		
main frame	102 x 203 mm	
boom	152 x 203 mm	
TIRES:	6, 11 L x 15, 8-ply	
WEIGHTS:	**FIELD POSITION**	**TRANSPORT POSITION**
right mainframe	1270 kg	1970 kg
left mainframe	1270 kg	1800 kg
right wing	514 kg	1900 kg
left wing	514 kg	1900 kg
hitch	-145 kg	-125 kg
TOTAL		7435 kg
SERVICING:		
grease fittings	28, every 100 hours	
	8, every 20 hours	
wheels bearings	6, service annually	

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

(a) excellent	(d) fair
(b) very good	(e) poor
(c) good	(f) unsatisfactory

APPENDIX III

CONVERSION TABLE

1 hectare (ha)	= 2.5 acres (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 meter (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 newton (N)	= 0.22 pounds force (lb)
1 newton/metre (N/m)	= 0.07 pound force/foot (lb/ft)

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