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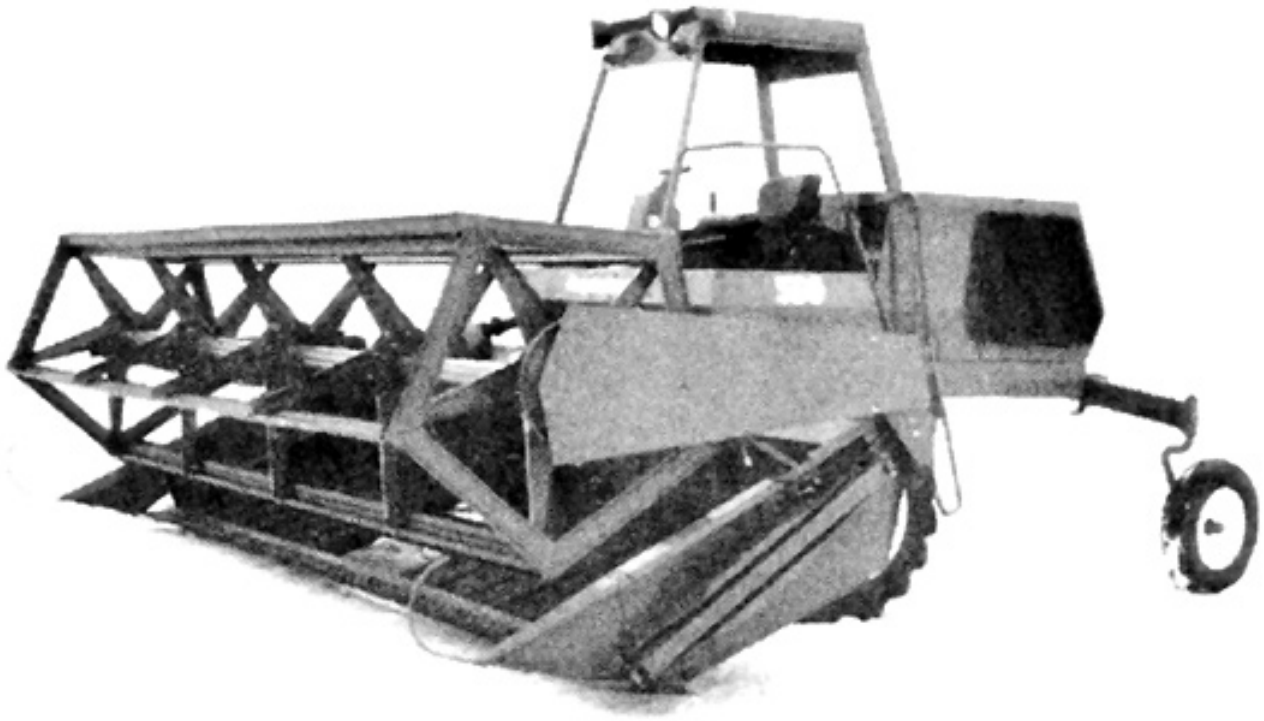
Evaluation Report 40



Co-op Implements 550Sp Swather

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

Co-op Implements 550SP Swather

Manufacturer and Distributor:

Canadian Co-operative Implements Limited
770 Pandora Avenue East
Winnipeg, Manitoba
R2C 3N1

Retail Price:

$10,500.00 (January, 1977, f.o.b. Humboldt, Saskatchewan)

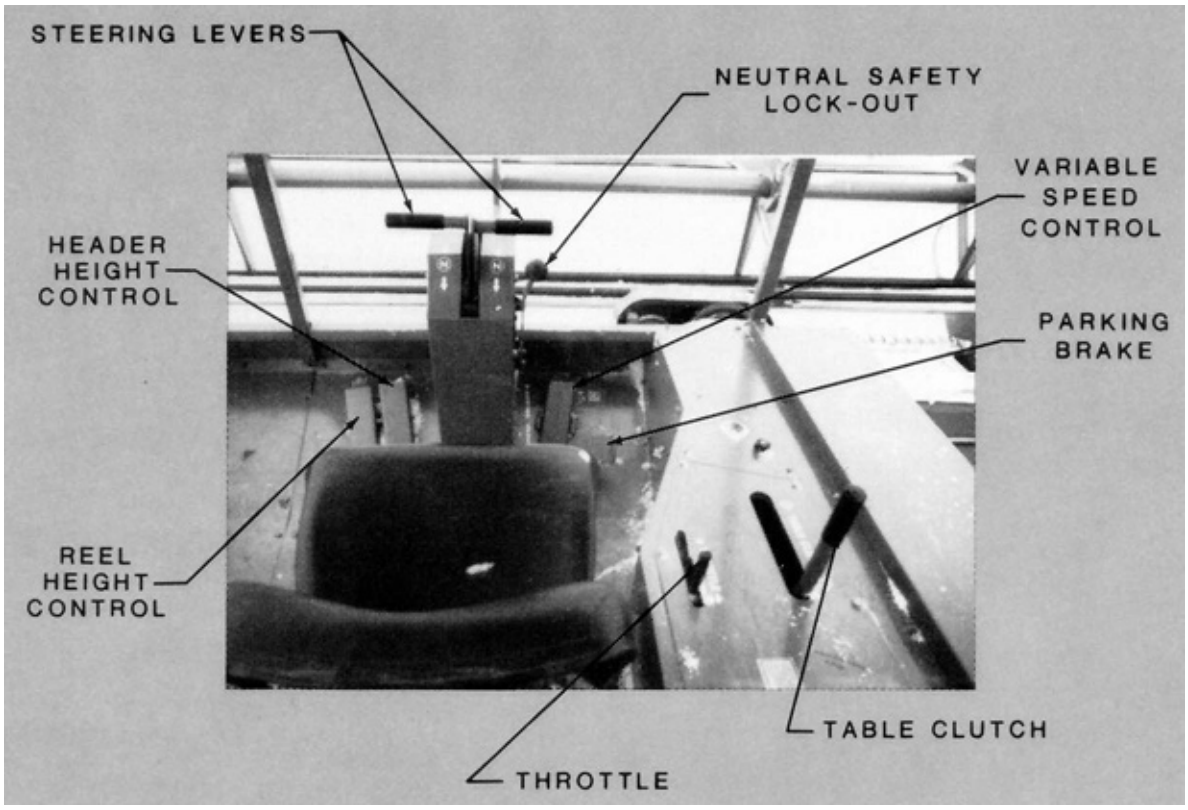


Figure 1. Detailed View of Co-op Implements 550SP.

Summary and Conclusions

Functional performance of the CI 550SP was *very good* in average grain crops. In heavy grain and rapeseed, performance was *fair* due to bunching and ineffectiveness of the dividers.

Performance of the CI 550SP when equipped with the standard 18 foot grain header was *good* in alfalfa and alfalfa brome mixtures but was *fair* in crested wheatgrass, redtop and slough grass, mainly due to limited speed range.

During 124 hours of operation, the durability of the CI 550SP was *very good.*

Windrow quality was *very good.* A herringbone pattern was formed in most crops. Cutting ability, when equipped with a 5500 mm (18 ft) grain header was *very good* in grain crops and succulent hay crops and *was fair* in tough hay crops. Suitable field speeds were 6 to 10 km/h (4 to 6 mph) in average grain crops. The minimum speed of 5.3 km/h (3.3 mph) was too fast for heavy grain crops or tough hay crops.

Controls for the CI 550SP were conveniently positioned and responsive. Handling characteristics and maneuverability were *fair.* Adjustment of draper speed and reel speed were convenient. Sound level at the operator's ear was about 88 decibels (A scale).

The engine had adequate power for all conditions. Normal fuel consumption was 5 L/h (1.1 gal/h).

No serious safety hazards were encountered when operated according to normal, safe operating procedures.

Recommendations

It is recommended that the manufacturer consider:

1. Widening the range of ground speed, to permit slower operating speeds for heavy crops.
2. Developing optional dividers for tall grain and rapeseed.
3. Modifying the divider boards to prevent "hairpinning" of leaning grain stalks.
4. Modifying the castor wheels to reduce shimmy at transport speeds.
5. Providing servicing facilities for the nitrogen charged accumulators, at the service depot level.
6. Modifying the fuel tank to reduce pressure buildup.
7. Changing the brake pedal angle to improve accessibility.
8. Modifying header assembly procedure to reduce the upward warp at the centre of the cutter bar.

Chief Engineer - E. O. Nyborg Senior Engineer - L. G. Smith

The Manufacturer States That:

With regard to recommendation number:

1. The speed range has been widened for 1977 by using a dual pulley arrangement in the final drive and an engine governor over-ride device. This gives the following speed ranges:

Field speeds at 2050 rpm:	*Road speeds at 2900 rpm:*
3.0 to 8.9 km/h (1.9 to 5.5 mph)	4.4 to 12.4 km/h (2.7 to 7.7 mph)
4.8 to 13.5 km/h (3.0 to 8.4 mph)	6.8 to 19.3 km/h (4.2 to 12.0 mph)

2. An optional design divider will be tested in 1977.
3. We will test for improved design in 1977.
4. For 1977, the castor wheels have been modified to prevent shimmy up to 19.3 km/h (12.0 mph).
5. C.I. depots now have charged accumulators in stock. Equipment to recharge is located in depots which can adequately cover the total sales area.
6. Specifications call for an anti-surge fuel tank cap to vent at 14kPa (2 psi) and to be removed with two distinct partial turns. The user will be advised to remove the cap carefully.
7. We will investigate this recommendation.
8. The 1977 manufacturing procedures and inspection insure a straight cutter bar. Additionally, a box type gusset has been fitted over the centre of the cutter bar.

General Description

The CI 550SP is a self-propelled centre delivery windrower with two traction drive wheels and two rear castor wheels. It is powered by a Ford Industrial, 200 cubic inch, six cylinder gasoline engine, through a variable speed belt drive and a planetary gear train to the drive wheels and a multiple V-belt to the header. It is controlled with low effort, hand lever operated steering and foot operated variable speed control. Several table options are available.

The CI 550SP described in this report was equipped with a 5500 mm (18 ft) grain header with a draper platform and standard reel.

Detailed specifications are given in Appendix I. Figure 1 shows the location of major components and controls.

Scope of Test

The CI 550SP was operated in the conditions shown in Table 1 for 124 hours while cutting approximately 450 ha (1125 ac). It was evaluated in forage crops, cereal grains and oil seed crops for windrow formation, cutting ability, ease of operation and adjustment, noise level, fuel consumption, operator safety and suitability of the operator's manual.

Table 1. Operating Conditions

Crop	Hours	Field Area ha (ac)	Soil Texture	Stony Conditions
Brome/Alfalfa	31	80 (200)	gravelly loam	very stony
Timothy	2	4 (10)	sandy loam	occasional stones
Mixed Hay	4	8 (20)	gravelly loam	moderately stony
Fall Rye	17	60 (150)	fine sandy loam	stone free
Barley	22	108 (270)	loam	stone free
Rapeseed	5	18 (45)	loam	stone free
Durum	4	16 (40)	loam	stone free
Flax	5	16 (40)	loam	stone free
Wheat	34	140 (350)	loam to clay loam	occasional stones to moderately stony

Results and Discussion

WINDROW FORMATION

Windrow Types: Windrows may be classified into four general types or patterns as shown in Figure 2. These are called: fantail, angled parallel, herringbone and parallel. There are, many variations and combinations of these distinct types. Table 2 outlines the types of windrows formed by the CI 550SP in various crops. The CI 550SP usually formed parallel windrows in heavy crops and herringbone windrows in lighter crops. In leaning or lodged crops, angled parallel and fantail windrows were often formed. Photographs of some typical windrows are shown in Figures 3 to 11.

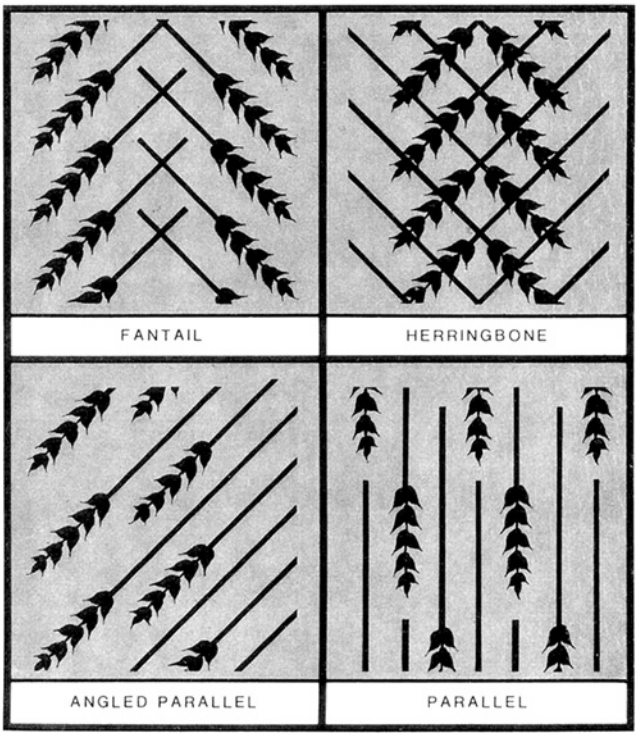


Figure 2. General Types of Windrows.

Table 2. Windrows Formed By The Co-op Implements 550SP in Various Crops

Crop	Yield t/ha	Crop Height mm (in)	Stubble Height mm (in)	Speed km/h (mph)	Windrow Type	Windrow Uniformity	Windrow Density	Remarks	Figure Number
Brome/ Alfalfa	2.3 (1 ton/ac)	450 (18)	50 (2)	5.3 (3.3)	Mixed parallel & herringbone	Non-uniform	Low	Lowest speed too high in heavy spots and on rough ground	3
Timothy	2.3 (1 ton/ac)	750 (30)	50 (2)	5.3 (3.3)	Parallel and fantail	Uniform	High		4
Fall Rye	1.9 (30 bu/ac)	1000 (40)	200 (8)	6.5 (4)	Parallel	Uniform	High	Lowest speed too high in lodged areas.	
Barley	2.5 (45 bu/ac)	1000 (40)	150 (6)	8 (5)	Herringbone	Uniform	High	Lowest speed too high in lodged areas.	5
Barley	3.8 (70 bu/ac)	1500 (60)	250 (10)	8 (5)	Angle Parallel	Non-uniform	High	Bunching due to hang-up on divider during side wind	6
Barley	1.6 (30 bu/ac)	750 (30)	100 (4)	8 (5)	Herringbone	Uniform	Medium		7
Rapeseed	1.7 (30 bu/ac)	750 (30)	250 (10)	5.3 (3.3)	Mixed	Non-uniform	Medium	Original divider unsatisfactory; PAMI modified divider satisfactory.	8 13
Durum	2.0 (30 bu/ac)	1000 (40)	100 (4)	6.5 (4)	Parallel to Herringbone	Uniform	High		9
Wheat	2.0 (30 bu/ac)	750 (30)	100 (4)	8 (5)	Parallel to Herringbone	Uniform	Medium		10
Flax	1.7 (30 bu/ac)	700 (28)	150 (6)	8 (5)	Parallel	Uniform	Medium	Uprooted plants at speeds above 8 km/h (5mph)	11

Figure 3. Brome and Alfalfa.

Figure 4. Fall Rye.

Figure 5. Barley (3.8 t/ha).

Figure 6. Barley (2.5 t/ha).

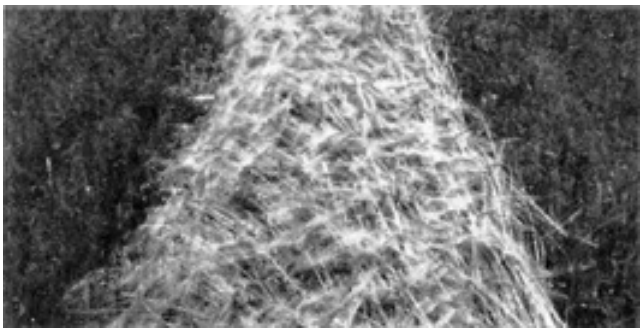


Figure 7. Barley (1.6 t/ha).

Figure 8. Rapeseed.

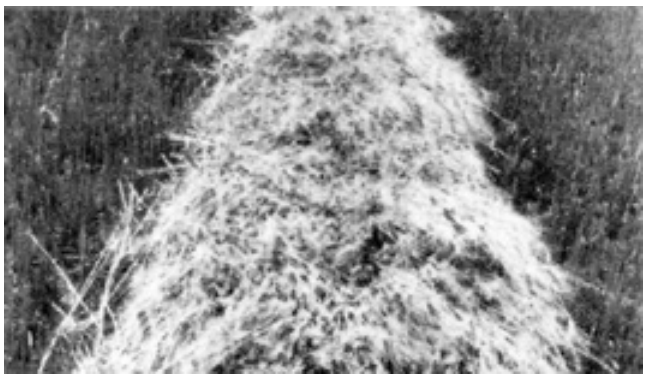


Figure 9. Durum.

Figure 10. Wheat.

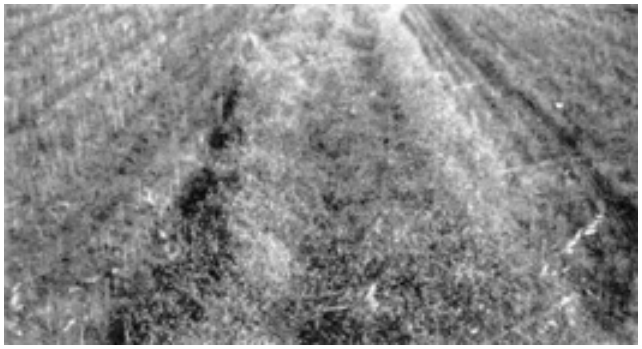


Figure 11. Flax.

Bunching: Uniform windrows were formed in most crops. In thin, short hay crops, bunching was caused by hay being retained on the cutter bar until enough buildup occurred to be contacted by the reel.

In leaning crops or when cutting in a side wind, bunchy and irregular windrows were sometimes formed due to occasional "hair-pinning" on the grain dividers.

Draper Speed: The draper roller speed could be varied from 840 to 1300 rpm by adjusting the drive pulleys. Even at the lowest draper speed, the windrows tended to be herringbone, except in tall heavy grain crops. High draper speeds produced a narrow dense windrow which was easier to pick, but required longer curing time.

Forward Speed: The forward speed had little effect on windrow type except in very heavy crops where the minimum forward speed was too fast to allow the crop to pass uniformly through the windrow opening. A lower ground speed is desirable in such crops. Ground speed was usually limited by field roughness or operator ability and not by windrow bunching.

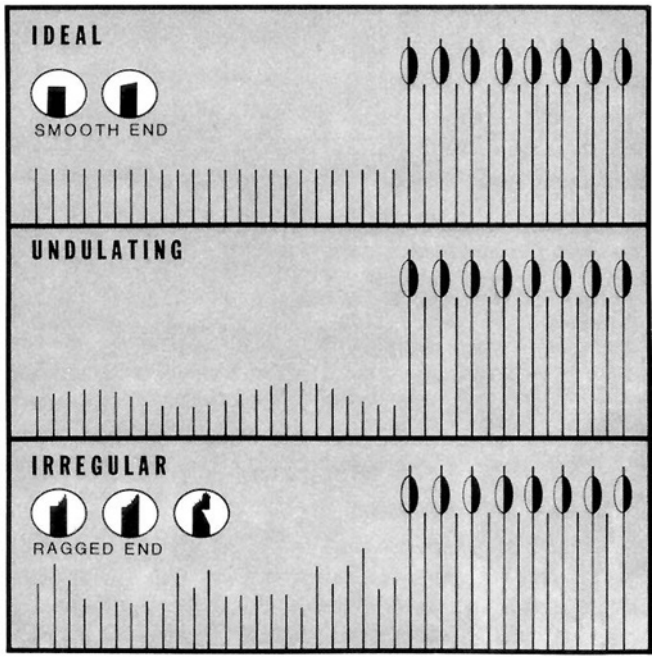


Figure 12. Types of Stubble.

CUTTING ABILITY

Stubble: The stubble formed by a windrower may be divided into three types as shown in Figure 12.

Grain Crops: The CI 550SP generally produced ideal stubble in all grain crops at speeds up to 11 km/h (7 mph) provided that the knife and guards were in good condition. In flax, ideal stubble was formed at speeds up to 8 km/h (5 mph). Higher speeds resulted in irregular stubble and some plants being uprooted rather than cut.

Hay Crops: The CI 550SP, when equipped with the 5500 mm (18 ft) grain header, produced ideal stubble in succulent hay crops at the minimum forward speed of 5.3 km/h (3.3 mph). In tough, wiry hay crops such as slough grass, crested wheatgrass and redtop, irregular stubble was often formed since the lowest forward speed was too fast to produce ideal stubble. In these crops, satisfactory cutting could be obtained by pulling back on the steering levers and riding the clutch to reduce forward speed. Extended operation of this manner would cause clutch overheating and the windrower was difficult to control. A lower forward speed is required for hay crops.

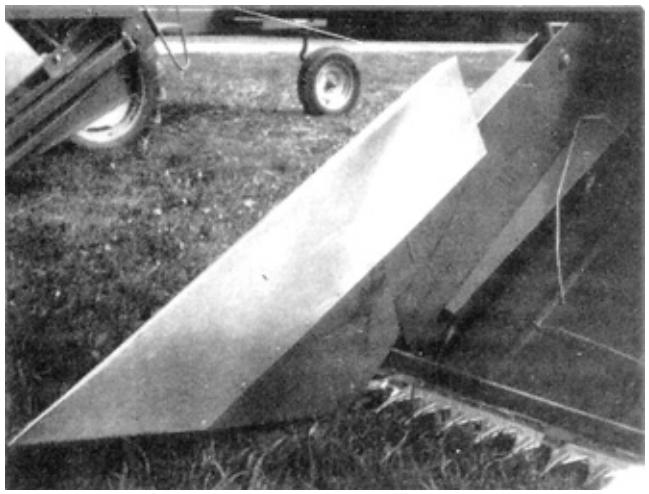


Figure 13. Modified Divider for Heavy Rapeseed.

Lodged Crops: In lodged grain, ideal stubble could be produced by floating the cutterbar on the ground and reducing forward speed. If lodging was severe, the lowest forward speed was too fast to prevent plugging unless the steering levers were pulled back to cause clutch slippage.

Dividers: In average straight standing grain and hay crops, the standard divider was satisfactory. In sideways leaning grain crops or when cutting with a strong side wind, the standard divider occasionally allowed grain stalks to hairpin over the divider top resulting in bunchy windrows. In tangled heavy rapeseed, the standard divider was unsatisfactory and field operation was not possible. Severe hairpinning on the divider resulted in uprooting of whole plants and cutterbar plugging. It must be noted that this is a common problem with many windrowers. A modified divider (Figure 13) was fabricated

by the Prairie Agricultural Machinery Institute. This divider performed satisfactorily in heavy rapeseed if the cutterbar was operated just below the lowest seed pods.

Table Flotation: This table on the CI 550SP is supported on a centre pivot. Up and down flotation is provided through the use of a nitrogen charged hydraulic accumulator. The center pivot provides end-to-end float.

When the windrower was received, the accumulator had not been charged with nitrogen. The resultant lack of flotation caused breaking of guards and bending of the cutterbar when a semi-buried stone was struck. Attempts to have the accumulator charged were unsuccessful, since no service facilities were available locally. After obtaining and installing a new accumulator, table flotation was *very good,* making it easy to follow irregular field contours. No further cutter bar damage occurred. Service facilities for accumulator charging should be available at the service depot level.

Reel: The reel index is the tip speed of the reel divided by the speed of forward travel. The reel index is an indication of how fast a windrower may travel for a given reel speed. Optimum values of reel index are from 1.1 to 1.2, meaning that the reel tip is travelling slightly faster than the ground speed and is pulling the crop toward the cutterbar. The reel speed on the CI 550SP could be varied from 33 to 50 rpm by adjusting the drive pulley. This permitted operation from 7 to 12 km/h (4.5 to 7.4 mph) with an optimum reel index which was adequate for all crops encountered.

Cutter Bar: As received from the manufacturer, the ends of the cutter bar were 25 mm (1 in) lower than the middle. Although this is not serious, it could likely be eliminated by modification of the assembly procedure at the factory. Inspection of several other CI 550SP swathers indicated that they had similar upward curvature at the centre of the cutter bar.

EASE OF OPERATION AND ADJUSTMENT

Steering: Directional control and maneuverability of the CI 550SP were *fair* except when maneuvering in close situations such as around fuel tanks and through narrow gates where maneuverability was *poor.* The low effort hand lever operated steering required a pull of 31 N (7 lb) at the neutral position and about 89 N (20 lb) in the full' reverse position.

In soft fields there was a tendency for the CI 550SP to pull sideways. This problem could be largely overcome by adjusting tire pressures until the windrower proceeded in a straight line.

Brakes: Emergency braking is provided by a foot operated brake pedal. Due to the high angle of the brake pedal, the brakes were difficult to apply in an emergency. The brakes were adequate on a 20% slope. Operators should apply the brakes when the windrower is stationary and idling as it may creep on hard ground if the clutch linkage is not properly adjusted.

Transporting: When the CI 550SP was transported with a windrower transporter, severe castor wheel shimmy occurred at speeds above 16 km/h (10 mph). Modifications are required to reduce castor wheel shimmy.

Controls: The reel and platform controls were operated by foot pedals. These controls were responsive and conveniently located.

Adjustments: Reel and draper speed could be easily adjusted by a variable pitch sheave. Adjustment required loosening the belt, loosening a set screw, turning the sheave and re-tightening.

NOISE LEVEL

The total noise at operator ear level was about 88 decibels (A scale) when operating on flat fields at normal speed, in average wheat crops. According to current operator exposure recommendations, this level is not expected to cause any permanent impairment during 8 hours of operation per day.

POWER AND FUEL CONSUMPTION

The engine on the CI 550SP had adequate power for all conditions encountered. Average fuel consumption was 5 L/h (1.1 gal/h). Fuel consumption would be greater under extreme conditions.

The 136 L (30 gal) fuel tank, permitted 25 to 30 hours operation between fillings, which was found to be quite convenient during extended operating hours as normally experienced during harvest. Operators should be cautioned to remove the fuel tank cap slowly on a hot day because of pressure buildup in the non-vented tank.

OPERATOR SAFETY

Since the centre of gravity on the CI 550SP was above and slightly behind the main drivewheels the windrower had a tendency to tip forward down steep slopes or during sudden stops. This was not considered particularly hazardous to the operator unless the machine was travelling at high. speed and the steering levers were suddenly pulled back, resulting in the operator being thrown forward and losing control.

Due to the imprecise maneuverability of the CI 550SP, extreme caution should be exercised when loading onto a truck or when maneuvering near steep embankments.

OPERATOR'S MANUAL

The operator's manual contained much useful information on operation, adjustment and servicing. It was clear and well written.

Durability Results

The CI 550SP was operated for 124 hours while cutting 450 ha (1125 ac). Since the intent of the test was functional evaluation, an extended durability evaluation was not conducted. Table 3 represents the mechanical history of the CI 550SP during the test. Consider each item separately since some are not as serious as others.

Table 3. Mechanical History

Item	Operating Hours	Equivalent ha	(ac)
A faulty battery was replaced at	beginning of test		
The bolt (P/N 12788) attaching the knife sway bar to the pitman arm failed due to over-tightening at assembly and was replaced at	8	20	(50)
The header drive belt guide bracket broke and was welded at	41	100	(250)
The right reel cylinder seal (P/N 1196) failed and was replaced at	53	144	(360)
The right clutch shaft locking collar (P/N 196) failed and was replaced at	124	450	(1125)

Discussion of Mechanical Problems

The only significant item in the mechanical history was the failure of the right clutch shaft locking collar. Collar failure caused the inner bearing race to rotate on the shaft necessitating shaft rebuilding. It is believed that locking collar failure was caused by over-tightening during assembly.

APPENDIX I

SPECIFICATIONS

Model: Co-op Implements 550SP Swather

Serial Number: May 76 11173

Cutter Bar:	
-width of cut (divider points)	5512 mm (217 in)
-effective cut (inside divider)	5397 mm (212.5 in)
-range of cutting height	-63 mm to 762 mm (-2.5 in to 30 in)
-guard spacing	76 mm (3 in)
-length of knife section (underserrated)	76 mm (3 in)
-knife stroke	79 mm (3.1 in)
-knife speed	55 cycles/min
-platform angle	
-fully raised	5° above horizontal
-fully lowered	27.5° below horizontal
-number of drapers	2
-width of draper	1041 mm (41 in)
-draper speed range	2.5 to 3.9 m/s (495 to 770 ft/min)
-draper roller diameter	57 mm (2.25 in)
-height of windrow opening	914 mm (36 in)
-width of windrow opening	
-between roller shields	881 mm (34.7 in)
-between rollers	978 mm (38.5 in)
-between windboards	1181 mm (46.5 in)
-raising time of table	2.5 s
--lowering time of table	3.0 s
Reel:	
-number of bats	5
-number of reel arms per bat	5
-diameter	1384 mm (54.5 in)
-speedrange	33 to 50 rpm
-range of adjustment	
-fore and aft	229 mm (9 in)
-height above cutterbar	25 mm to 762 mm (1 in to 30 in)
-raising time	1.8 s
-lowering time	2.4 s
-index at maximum ground speed and maximum reel speed	1.1
Ground Drive:	
-type	variable pitch belt to planetary wheel hubs
-speed control	foot operated
-range of forward speed	5.3 to 11.9 km/h (3.3 to 7.3 mph)
-range of reverse speed	2.4 to 5.5 km/h (1.5 to 3.4 mph)
Steering:	
-low effort, hand-lever operated	
Brakes:	
-foot operated band brakes	
Hydraulic system:	
-table and reel lift -Cessna Model 24257-LAC, belt driven from engine.	
No. of Chain drives:	*1*
No. of V-belt drives:	
-(single V)	6
-(multiple V)	3
No. of lubrication points:	
(pressure)	18
No. of pre-lubricated bearings:	30

Engine:	
-make	Ford
-model	200 GF-6005-ASOC520
-power	45 kW (60 hp) @ 2000 rpm, manufacturer's rating
-no load speed	2050 rpm
Tire Size:	
-main drive wheels	2 - 11.2 x 24, 4 ply rating
-castor wheels	2 - 6.70 x 15, 4 ply rating
-wheel tread	2514 mm (99 in)
-wheel base	2490 mm (98 in)
-overall width	5690 mm (224 in)
-overall length (reel and platform raised)	5461 mm (215 in)
-overall length (reel and platform lowered)	5359 mm (211 in)
Weight as tested:	
-right drive wheel	1066 kg (2345 lb)
-left drive wheel	1123 kg (2470 lb)
-castor wheels	252 kg (555 lb)
-Total Weight	2441kg (5370 lb)
Centre of Gravity:	
-height above ground	991 mm (39 in)
-distance behind drive wheels	257 mm (10.1 in)
-distance left of right drive wheel	1295 mm (51 in)

Standard Equipment:

- -operator's canopy with acoustic padding
- -sealed beam field lights
- -road lights and reflectors
- -deluxe seat
- -heavy duty battery (430 cranking amp.)
- -spark arrestor muffler

Attachments Available:

- -hay conditioner
- -pressurized canopy enclosure

APPENDIX I1

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

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

APPENDIX III

METRIC UNITS

In keeping with the Canadian metric conversion program, this report has been prepared in SI units. For comparative purposes, the following conversion may be used:

1 hectare (ha)	= 2.47 acres (ac)
1 kilometre/hour (km/h)	= 0.62 miles/hour (mph)
1 tonne (t)	= 2204.6 pounds (lb)
1 tonne/hectare (t/ha)	= 0.45 ton/acre (ton/ac)
1 metre (m) = 1000 millimetres (mm)	= 39.37 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds (lb)
1 litre/hour (L/h)	= 0.22 Imperial gallons/hour (gal/h)
1 newton (N)	= 0.22 pounds force (lb)
1 kilopascal (kPa)	= 0.15 pounds/square inch (psi)

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