Evaluation Report No. E0680A
Printed: December, 1981
Tested at: Portage la Prairie
ISSN 0383-3445

Evaluation Report 244

Versatile Hydrostatic 4400 Self-Propelled Windrower

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

VERSATILE HYDROSTATIC 4400 WINDROWER

Manufacturer and Distributor:

Versatile Farm Equipment Company
1260 Clarence Avenue
Winnipeg, Manitoba
R3T 1T3

Retail Price: $18,840.00 (November, 1981, f.o.b. Winnipeg, Manitoba, with hay crimper, double-swath attachment and operator cab)

SUMMARY AND CONCLUSIONS

Overall functional performance of the Versatile 4400 windrower was *very good* in all crops.

Cutting ability was *very good* in all grain and hay crops of average yield. Header fioatation was *very good.* Maximum header lift was adequate to clear heavy windrows.

Windrow formation was *very good* in both single or double windrowing. Parallel, angled parallel, and fantail windrows were predominant in grain crops. Fantail windrows occurred in most heavy crops while herringbone patterns occurred in light crops. On-the-go draper and reel speed adjustments permitted the operator to effectively maintain windrow quality and reduce shatter losses.

Double windrowing required vigilant operator control, due to the narrow divider margin. The divider had to run immediately adjacent to the first windrow, when laying the second windrow. Even slight deviation in travel direction resulted in hairpinning of the windrow or missed crop.

The header windrow opening was adequate for all crops. Maximum speeds were about 11 km/h in average grain crops and about 9 km/h in average hay crops.

Operator controls were convenient and well positioned, however the proximity of the speed control lever to the header drive lever occasionally resulted in confusion. It was sometimes difficult to find the neutral position in the speed control lever during quick maneuvers.

Operator station sound level was about 87 dBA.

Most adjustments were simple and convenient. Daily maintenance took about 10 minutes.

Visibility from the operator's platform was *excellent.* Stability on slopes was *very good.*

Performance of the optional hay crimper was *very good.* It was convenient to install. Feeding was aggressive. The engine had ample Power to handle the crimper in all conditions.

The operator manual was *very good.*

A number of minor durability problems occurred during the test.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to the operator controls to prevent operator confusion between the speed and header drive levers, to clearly define and ease the finding of the speed control neutral position and to provide more responsive header height control.
2. Including operator instructions on adjustment of the travel speed control lever tension.
3. Providing a means of retaining the crimper drive belt when the crimper is detached.
4. Modifications to improve durability of the draper tension locks and to permit easier adjustment of the draper positioning chains.

Chief Engineer -- E. O. Nyborg
Senior Engineer -- J. C. Thauberger
Project Engineer -- R.R. Hochstein

THE MANUFACTURER STATES THAT:

With regard to recommendation number:

1. The speed and header drive controls were redesigned for 1981 production.
2. Instructions regarding the adjustment of speed control tension will be added.
3. A retainer will be added for this purpose.
4. Material, process and design changes have been made to improve the durability of the draper tension locks. Improvement in draper positioning adjustment cannot presently be incorporated but will be considered for new designs.

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

GENERAL DESCRIPTION

The Versatile 4400 is a self-propelled, double-swath windrower, capable of centre, left or right end delivery. It is supported by two traction drive wheels and d ual rear caster wheels. It is powered by a Ford Industrial, six cylinder gasoline engine. The traction drive is hydrostatic with two pumps driven through a series of sheaves and belts from the engine crankshaft. Roller chains transmit power from the hydrostatic motors to the wheels. The cutterbar is driven through a belt and d riveshaft arrangement while the reel and draper components are driven by hydraulic motors.

Draper speed, position and direction of rotation, as well as reel speed, are adjustable from the operator station. A steering wheel and a lever on the console control the direction and speed of travel. The header and reel lift control are foot operated.

The test machine was equipped with a 6.1 m (20 ft) double swath grain header with draper platform, bat reel, and an optional hay crimper.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Versatile 4400 was operated in the conditions shown in Table 1 for 227 hours while cutting about 722 ha (1780 ac). It was evaluated in forage crops, cereal grains and oil seed crops for windrow formation, cutting ability, ease of operation and adjustment, sound level, fuel consumption, operator safety and suitability of the operator manual.

TABLE 1. Operating Conditions

Crop	Operating Mode	Hours	Field Area (ha)
Alfalfa	centre delivery (with crimper)	67	215
Slough grass		7	20
Millet		8	28
Barley	centre delivery	43	175
Wheat		9	34
Oats		2	6
Flax		12	30
Buckwheat		4	14
Rapeseed	centre delivery	39	100
Wheat (lodged)		5	10
Peas		15	30
Wheat	alternating end delivery (double swath)	11	44
Oats		5	16
TOTAL		227	722

RESULTS AND DISCUSSION

WINDROW FORMATION

Windrow Types: Windrows may be broadly classified into four general patterns (FIGURE 1) although many combinations and variations exist. The Versatile 4400 produced parallel, angled parallel and fantail windrows in most grain crops. Herringbone windrows occurred in light crops, with short stem height, while fantail windrows occurred primarily in heavy crops. Ground speed had little adverse influence on windrow formation, due to the convenience of instantaneous adjustment of reel and draper speed. APPENDIX IV illustrates typical windrows, formed by the Versatile, in different crops.

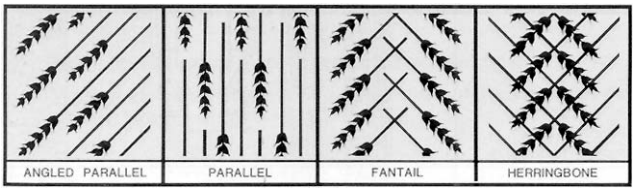

FIGURE 1. Windrow Types.

Leaning Crops: Direction of travel was important when windrowing lodged or leaning grain crops. Cutting in the direction of crop lean resulted in parallel windrows, while cutting at an angle to the direction of lean generally resulted in angled parallel windrows.

Uniformity: Windrows were very uniform in most crops. Bunchling occurred only in badly lodged crops and in heavy stands of rapeseed. In lodged cereal crops, bunching was primarily due to crop accumulation on the cutterbar, while in rapeseed, bunching occurred at the dividers at speeds above 8 km/h (5 mph).

Draper and Reel Speed: Reel and draper speeds were easily adjusted from the operator station to control both windrow formation and reel shatter loss. One control valve on the console simultaneously controlled the speed of both reel and drapers. The draper speed was variable from 0 to 2.8 m/s (0 to 9.2 ft/sec) for the right draper and from 0 to 3.5 m/s (0 to 11.5 ft/sec) for the left draper. The speed of the left draper could be adjusted, in relation to the speed of the right d raper, with a separate flow control valve located on the header. The reel speed was variable from 0 to 55 rpm. Reel tip speed varied from 0 to 3.9 m/s (0 to 12.8 ft/sec).

Once a suitable ground speed was selected, it was usually best to adjust the reel speed so that it just caused the stems to fall on the drapers. Since the reel and draper speeds were synchronized with one control, this setting was usually Optimum for the drapers and resulted in a favorable windrow. A fantail or parallel windrow usually resulted at a reel speed index between 1.1 and 1.2. Draper speed had little influence on windrow formation.

Header Angle: The header angle was variable which allowed adjustment from a steep guard angle, for cutting forage crops and downed cereal crops close to the ground, to a low draper angle for cutting grain crops. The draper angle could be adjusted from about 13° for grain, (measured with header height set for a 200 mm (8 inch) stubble) to 22° for hay (measured with the cutterbar operated at ground level).

Travel Speed: Windrow formation was sometimes influenced by the relation of the reel and draper speed to the travel speed. A significant increase in ground speed, without adjustment of the reel speed, usually resulted in a non-uniform windrow. It was necessary to maintain a reel index of 1.1 to 1.2. Maximum forward speed was usually limited by field roughness and cutting ability of the windrower.

Double Windrowing: Double windrowing was done by alternately setting the drapers for right and left end delivery, with the selectors on the steering column. An angled parallel windrow usually resulted when cutting straight standing crops of wheat and barley. Crop lean opposite to the draper travel direction resulted in parallel windrows. Both types of windrows were satisfactory for weathering and picking with a combine.

Windrow Opening: Windrow opening clearance was adequate for both centre and end delivery, even in very heavy, matted crops such as rapeseed. Clearance under the windrower frame and between the drive wheels was adequate.

CUTTING ABILITY

Cutterbar: All test work was conducted with low-rise over-serrated knife sections. Cutting ability was excellent in grain crops and good to very good in hay crops. Cutterbar plugging occasionally occurred in heavy sloughgrass and damp flax, although cutterbar hammering did not result.

In hay crops, the maximum forward speed of 7.5 km/h (4.5 mph) was governed by the ability of the cutterbar to cut.

Dividers: Divider performance was excellent in average stands of grain and hay crops and adequate in lodged crops. When cutting rapeseed, it was usually best to cut back and forth since the dividers worked on the principle of pushing the crop down at the divider. The resulting narrow path of pushed down crop was best recovered while cutting in the opposite direction on the next pass. In heavy, green, matted rapeseed it was necessary to operate with the reel almost completely lowered to clear the cutterbar of crop near the divider.

Header Floatation: Header floatation was adequate both for cutting hay and pulse crops close to the ground and for cutting cereal crops at normal stubble heights. At the recommended floatation setting, the windrower negotiated stones along the ground and followed ground contour very well. When cutting cereal crops, with the header off the ground at the recommended floatation setting, the floatation was sensitive to field roughness. At speeds greater than 8 km/h (5 mph), undulating stubble usually resulted.

Hay Crimper: Performance of the optional hay crimper was *very good.* Feeding was aggressive. Plugging occurred only rarely.

EASE OF OPERATION AND ADJUSTMENT

Operator and Controls: The Versatile 4400 was equipped with an optional operator cab. Visibility of the header and dividers was excellent. The operator had full view of the cutterbar and header without having to sit forward on the seat. Steering wheel tilt and telescoping adjustment, seat position adjustment and operator weight adjustment provided comfort for a wide range of operators.

Most of the controls were conveniently placed and easy to use (FIGURE 2). The header drive control and the ground speed controls used identical levers and were located in close proximity to each other. When quick action was needed the levers were easily mistaken. As well, when quick movement of the speed control lever was needed, the windrower was often inadvertently reversed before the neutral detente was found. It is recommended that the manufacturer consider modifications to reduce the possibility of mistaken operation and to provide a positive neutral position on the speed lever.

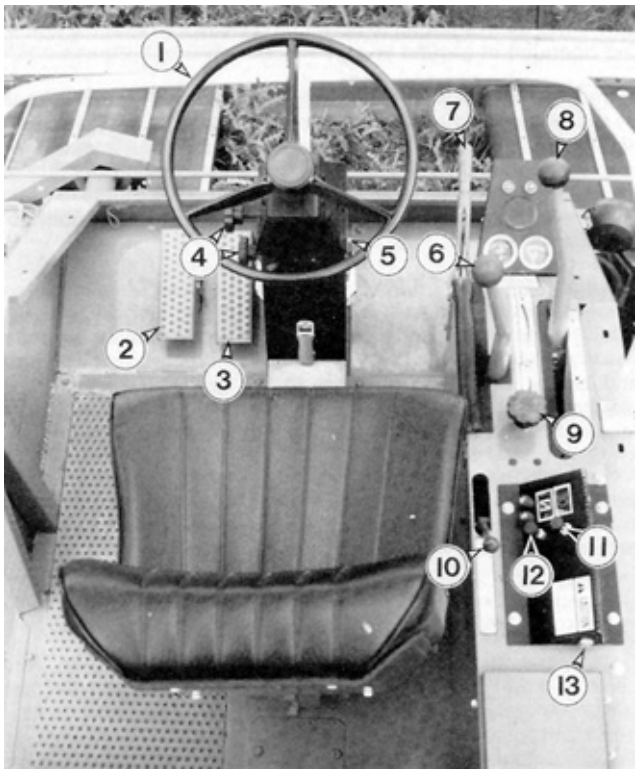

FIGURE 2. Operator Station. (1) Steering wheel, (2) Reel height control pedal, (3) Header height control pedal, (4) Steering wheel position locks, (5) End centre delivery selectors, (6) Travel speed control lever, (7) Parking brake, (8) Header drive control lever, (9) Reel and draper speed control, (10) Throttle, (11) Light switch, (12) Choke, (13) Ignition switch.

The header and reel height controls, located to the left of the steering column, were foot operated. Pedal angle was adjustable to suit the operator. Although these controls were convenient, it was often necessary to slow forward motion to await lowering of the header, when the header control was used frequently. It is recommended that the manufacturer consider modifications to permit more responsive header height control. The reel height control response was good. The speed control for the reel and draper was located on the console while end/centre delivery selector controls were conveniently located on the steering column.

The cab was relatively dust free. The two-speed fan provided adequate ventilation during hot weather.

Total noise at the operator ear level was about 87 dBA with ventilating fan operating and about 88 dBA with the door and window open with the fan off.

Steering: Directional control and maneuverability were very good. Steering was positive and effortless. The Versatile did not pull sideways in soft fields or on moderate slopes.

Travel Speed Control: Travel speed was variable from 0 to 19 km/h (0 to 12 mph) in the forward direction and from 0 to 11 km/h (0 to 7 mph) in reverse. During initial testing, the speed control was stiff and difficult to operate. Ease of operation was improved by adjusting a clamp on the control linkage, however this adjustment was not outlined in the operator manual. It is recommended that the manufacturer include instructions on this adjustment in the operator manual.

Braking: Hydrostatic braking was accomplished with the speed control lever. Braking motion was often jerky due to the tendency of the windrower to tip forward onto the header. Rear ballasting was added to improve stability. A mechanical parking brake and a warning buzzer, which sounded if the parking brake was not engaged in neutral, were provided.

Transporting: For towing with the drive wheels on the ground, the final traction drive chains had to be removed. Backing the windrower onto a transporter required that the transporter be parked against a grade, since the maximum safe downward slope the windrower could negotiate, with the rear wheels in contact with the ground, was 21°. Rear wheel ballast increased stability and reduced this loading problem.

Double Windrowing: To lay a double windrow, the first wind row was placed next to the standing crop. To place the second windrow the outboard divider had to pass immediately adjacent to the first windrow (FIGURE 3). As a result, slight deviations in travel direction resulted in a strip of uncut crop or hairpinning of crop from the previous windrow. Operator vigilance was necessary to minimize crop losses.

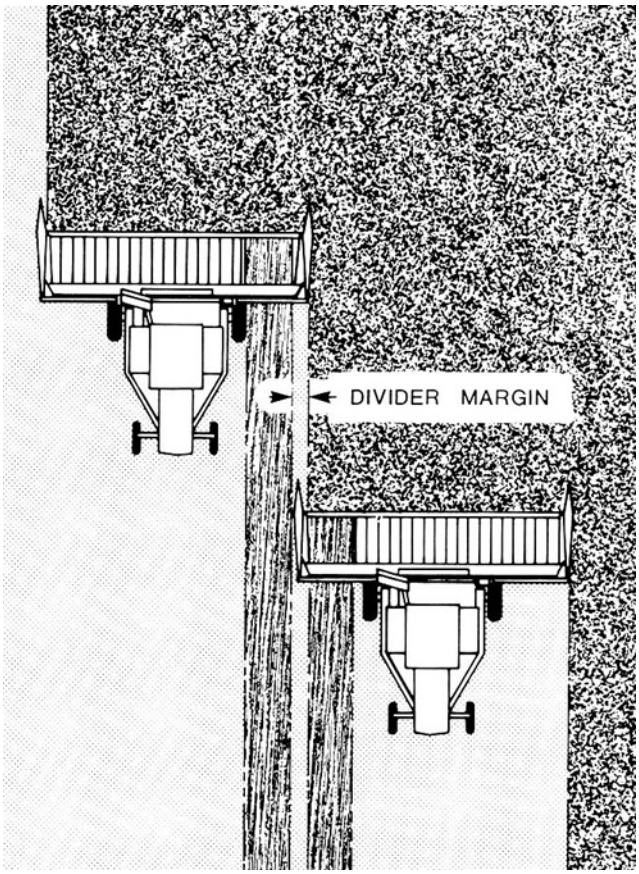

FIGURE 3. Double Windrowing.

Cornering presented no problems while double windrowing. The draper positioning controls were responsive and easy to use.

Hay Crimper: The optional crimper could be installed in thirty minutes, and removed in ten minutes by one man. Two cables, attached to the undercarriage of the windrower, helped align the crimper by backing the windrower until both cables were extended equally. The crimper was then lifted into place by cables connected to the header lift.

Crimper roller timing, roller pressure and floatation were all easy to adjust. Lubrication of the crimper drive chains was difficult. Removing the crimper required that the drive belt be secured in place, away from the drive pulley, to prevent rubbing since it could not be easily removed from the drive shaft. It is recommended that the manufacturer provide a belt holder for properly retaining the drive belt when the crimper is temporarily detached.

Adjustments: Draper and guard angle were adjusted simultaneously, to suit crop conditions, by varying the length of the header levelling chains on either side of the header support. A steep guard angle was best in lodged grain crops and hay crops whereas a low draper angle was best in grain crops. The operator manual did not recommend appropriate adjustments in d raper or guard angle for specific crops.

The sliding drapers, for double wind rowing, operated smoothly throughout the test. The positioning mechanism needed adjustment three times during the test. This adjustment was inconvenient (FIGURE 4) due to the closeness of the bracket to the chain tension adjustment.

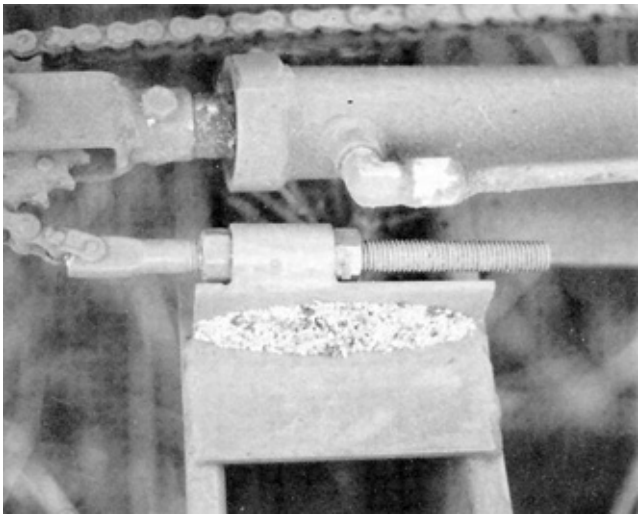

FIGURE 4. Draper positioning chain adjustment.

The reel lift range and clearance were varied by adjusting the lower or upper cylinder mounts. Header lift range could be adjusted to three different settings. This adjustment was easily made by positioning a jack in the line of action of each lift cylinder. Both cylinders could be adjusted in ten minutes.

The knife register and sway bar knife clearance were easy to adjust. This adjustment was well documented in the operator manual.

The draper tension was inconvenient to adjust. The explanatory decal, outlining the correct procedure, was difficult to understand.

Header floatation adjustment was convenient.

Servicing: Daily lubrication and inspection of the Versatile 4400 took about ten minutes.

POWER AND FUEL CONSUMPTION

The engine had sufficient power for all conditions, including operation of the hay crimper. Average fuel consumption, while wind rowing wheat, was 13.2 L/h (2.9 gal/h). The 120 L (26 gal) fuel tank permitted about 9 hours of operation between fillings.

OPERATOR SAFETY

Access to the operator station was safe and convenient. Controls were well positioned relative to the operator. However the closeness of the header drive control lever to the speed lever created a potentially unsafe condition. When quick action was required the control levers were easily mistaken for one another. The two headlights and rear working light provided good illumination for night operation. The slow moving sign on the rear and flashing safety lights provided proper marking for transport on public roads.

Safety blocking devices were provided on hydraulic cylinders to permit safe servicing and maintenance to the header. All components were well shielded.

A safety lockout permitted starting of the engine only when the parking brake was engaged. A warning buzzer was provided to remind the operator to engage the parking brake when the control was in neutral.

OPERATOR MANUAL

The operator manual was clear, concise and contained much useful information on the operation of the windrower. No information was provided on adjusting the travel speed control linkage to provide easier lever movement.

DURABILITY RESULTS

TABLE 2 outlines the mechanical history of the Versatile 4400 windrower during 227 hours of operation while windrowing 722 ha. The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted.

TABLE 2. Mechanical History

Item	Operating Hours	Equivalent Field Area (ha)
The windrow guide shield on the hay crimper detached at	11	35
The header drive shaft coupler slipped, shearing the key at	25, 45, end of test	80,140 722
The throttle lever friction clamp required tightening at	25, 55, 90	80, 175, 286
A rubber bumper for spacing the crimper rolls was lost and replaced at	30	95
The right draper positioning cylinder began leaking and was replaced at	45	140
The chain on left draper positioner broke and was repaired at	55, 60, 80	175, 190, 255
Broken draper slats were replaced at	70	225
The bolt attaching the swaybar to the pitman broke and was replaced at	70	225
The left draper tension lock had stripped teeth and was replaced at	80	255
The left draper was badly torn and replaced at	98	312
The engine governor failed and was replaced at	110	350
The left and right draper tension locks had stripped teeth and were replaced at	end of test	722
The left draper hydraulic motor drive coupler failed and was repaired at	end of test	722

DISCUSSION OF MECHANICAL PROBLEMS

Header Drive: The key attaching the flexible coupling to the header drive shaft sheared three times during the test. On the second and third occurrence the couplers and shaft were damaged and had to be replaced. Close examination indicated some shaft misalignment.

Draper Tension Locks: Three draper tension locks broke and were replaced during the test. It is recommended that the manufacturer consider modifications to the draper tension locks to improve durability.

Draper positioning chain: The draper positioning chain (FIGURE 4) was difficult to adjust due to inaccessibility of adjusting nuts. This contributed to the chain failures. It is recommended that the rnanufacturer provide easier adjustment of the draper positioning chains.

APPENDIX I

Specifications

Make:	Versatile
Model:	4400
Serial No.:	
-- tractor	003230
-- header	005940

Cutterbar:

-- width of cut (divider points)	6.0 m
-- effective cut (inside divider)	5.9 m
-- cutting height	60 mm
-- guard spacing	75 mm
-- length of knife section (overserrated)	75 mm
-- knife stroke	80 mm
-- knife speed	510 cycles/min

Header:

-- range of header angle (from horizontal)	13° to 20°
-- number of drapers	2
-- width of drapers	1060 mm
-- length of drapers	2300 mm
-- draper speed range	
-- left	0 to 3.5 m/s
-- right	0 to 2.8 m/s
-- draper roller diameter	63 mm

	Center delivery	*End delivery*
-- height of windrow opening		
-- 15° table angle	860 mm	800 mm
-- 21° table angle	780 mm	720 mm
-- width of windrow opening		
-- between windboards	1200 mm	1160 mm
-- between rollers	1180 mm	N.A.
-- raising time of header	2 sec.	
-- lowering time of header	5 sec.	

Reel:

-- number of bats	5
-- number of reel arms per bat	5
-- diameter	1370 mm
-- speed range	0 to 55 rpm
-- ground speed synchronization range	0 to 14 km/h
-- reel position adjustment	
-- fore and aft	150 mm
-- height above cutterbar	35 to 620 mm
-- raising time	0.75 sec
-- lowering time	2.0 sec

Traction Drive:

-- type	Sperry Vickers hydrostatic motors with chain drive speed reduction to wheels
-- speed control	hand lever
-- maximum forward speed	19 km/h
-- maximum reverse speed	8 km/h

Steering:

steering wheel operating hydrostatic pumps

Brakes:

hydrostatic control lever, disc parking brake operated by over-centre hand lever

Hydraulic System:

-- hydrostatic traction drive	(see Traction Drive)
-- reel and draper drives	auxiliary pump operating motors at reel and drapers
-- header and reel lift	master and slave cylinder assemblies
-- draper position	double acting cylinders

No. of Drive Chains:

-- header	1
-- tractor	4

No. of V-belts:

-- single V	4
-- multiple V	2

No. of Pressure Lubrication Points: *16*

No. of Prelubricated Bearings: *21*

Engine:

-- make	Ford Industrial
-- model	3.3 L, 6 cyl. gasoline
-- serial no.	38734
-- no load speed	2800 rpm
-- power	60 kW
-- fuel tank capacity	120 L

Tires:

-- main drive wheels	two, 11.2 x 24, 4 ply
-- caster wheels	two, 6.7 x t5, 6 ply

Overall Dimensions:

-- wheel tread	
-- drive wheels	2645 mm
-- caster rear wheels	2644 mm
-- wheel base	3020 mm
-- overall width	6240 mm
-- overall length	6100 mm
-- overall height	3035 mm

***Weight as Tested:* (header raised, fuel tank full)**

-- right drive wheel	1270 kg
-- left drive wheel	1460 kg
-- caster wheels (without ballast)	280 kg
-- Total	3010 kg

***Centre of Gravity:* (header raised, fuel tank full)**

-- height above ground	1160 mm
-- distance behind drive wheels	280 mm
-- distance left of right drive wheel	1415 mm

Hay Conditioner:

-- type	steel intermesh
-- weight	402 kg
-- conditioner rolls	
-- diameter	210 mm
-- length	1270 mm
-- speed	670 rpm
-- no. of chain drives	2
-- no. of V belts	
-- multiple V	1
-- grip	1
-- no. of pressure lubrication points	4
-- no. of prelubricated bearings	11

Options and Attachments Available:

-- Air conditioner

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

Conversion Table

1 hectare (ha)	= 2.5 acres (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 tonne (t)	= 2200 pounds mass (lb)
1 tonne/hectare (t/ha)	= 0.45 ton/acre (ton/ac)
1 metre (m)	= 3.3 feet (ft)
1 litre (L)	= 0.22 Imperial gallons (gal)

APPENDIX IV

TYPICAL WINDROW FORMATION

FIGURE 5. Wheat, Single windrow, Yield: 2.7 t/ha (40 bu/ac).

FIGURE 8. Rapeseed, Yield: 1.1 t/ha (20 bu/ac).

FIGURE 6. Wheat, Double windrow, Yield: 2.0 t/ha (30 bu/ac).

FIGURE 9. Alfalfa, Yield: 6.7 t/ha (3 ton/ac).

FIGURE 7. Barley, Yield: 2.7 t/ha (50 bu/ac).

ALBERTA FARM MACHINERY RESEARCH CENTRE

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute
Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:
P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080

This report is published under the authority of the minister of Agriculture for the Provinces of Alberta, Saskatchewan and Manitoba and may not be reproduced in whole or in part without the prior approval of the Alberta Farm Machinery Research Centre or The Prairie Agricultural Machinery Institute.